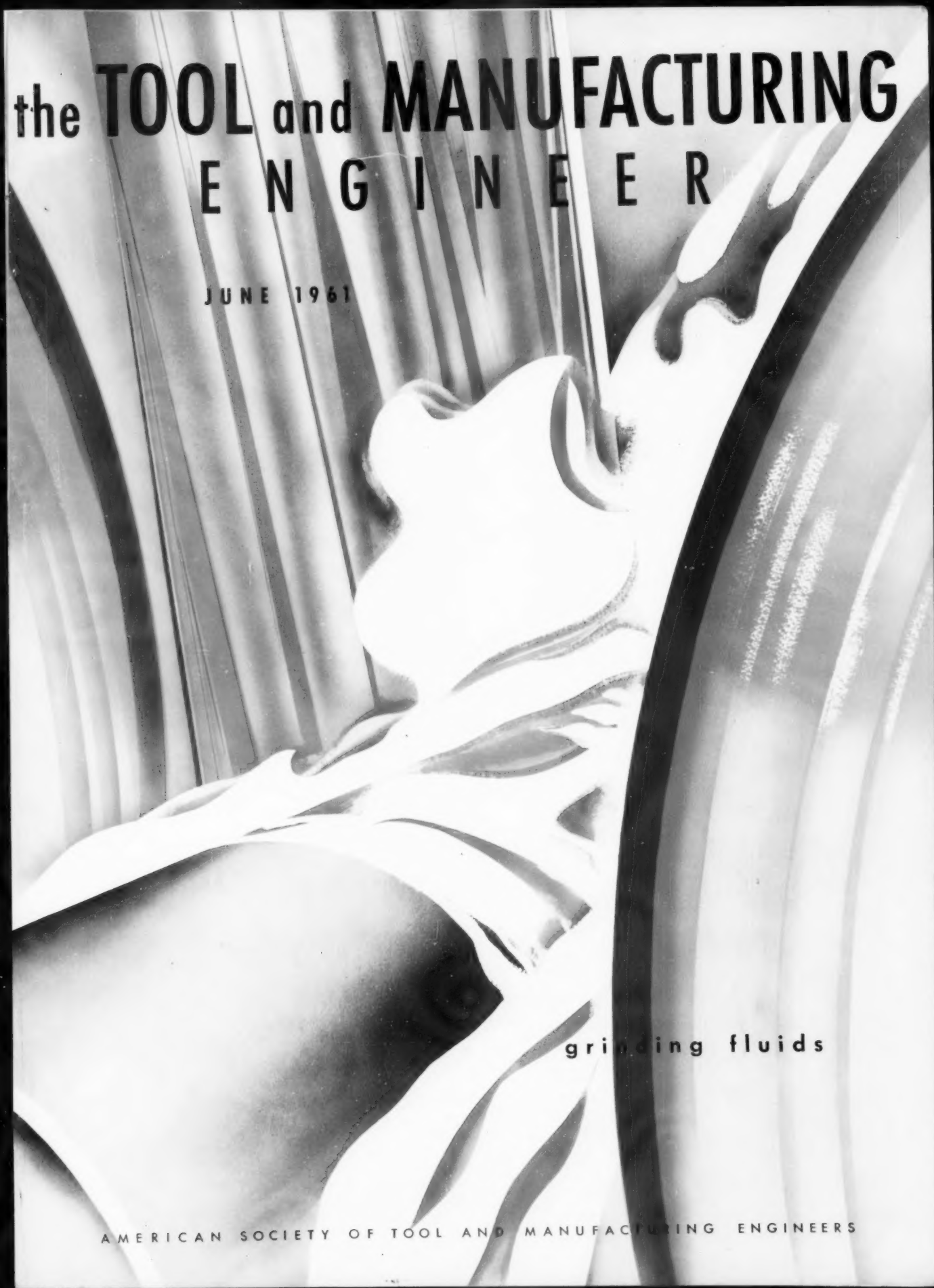
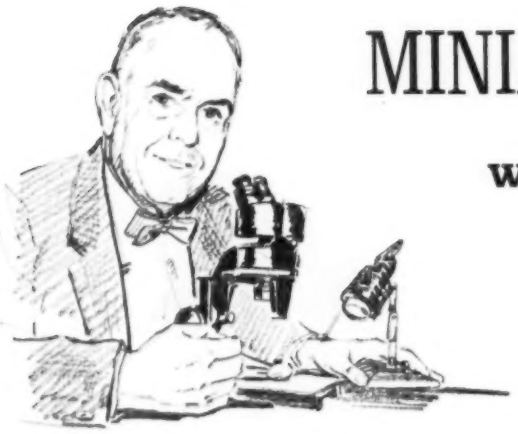
the TOOL and MANUFACTURING ENGINEER

JUNE 1961



grinding fluids

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS



MINIATURE GRINDING...

With A New Problem-Solving Internal

by Stuart St. John
Assistant Sales Manager
The Heald Machine Company

Seldom does any new machine represent all the answers to the desires of production people. But the new Model 090A and 0901A miniature internal grinding machines come mighty close. In fact, these new machines constitute a major break-through in the ability to control variables inherent to miniature internal grinding. This, in addition to substantially faster machine cycles, was made possible through a complete analysis of all miniature grinding techniques. Based on the findings of our research and development engineers, this machine was designed, produced and has proved its capabilities most convincingly. Here are some of these developments which have been incorporated in the new design and which have placed these machines well ahead of their time by present-day standards.

NEW models provide simpler, more reliable and infinitely adjustable wheel-wear compensation from 0 to .001 resulting in substantially longer wheel life.

NEW, lighter-weight vibration-damped cross slide on anti-friction ways gives concise and consistent repeatability.

SIMPLER, more efficient control and equipment arrangement permits easy service inspection through hinged doors at rear. No access necessary from either end.

NEW models feature a 75% reduction in hydraulic and electrical control equipment, simplified circuitry and ⅓ smaller electrical cabinet.

NEW feeding method gives greatly improved control of size and taper, increases accuracy by as much as 50%.

NEW direct-reading micrometer dials permit cross slide to be precisely positioned without use of dial indicators.

NEW cross slide resets automatically for wheel change; at press of button, machine automatically dresses wheel and re-enters cycle with resultant saving of operator time.

NEW direct-reading digital dial shows operator the amount of wheel life remaining at all times.

NEW, simpler, 3-piece guarding retains all coolant yet opens easily to expose complete machine.

These and other improvements make the 090A and 0901A miniature internals that challenge *any other machines* intended for this class of work. Your Heald engineer will be glad to arrange a demonstration for you.

Heald Model 090A precision internal, designed specifically for grinding miniature bores. Smallness of bore is limited only by the availability of small diameter wheels.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
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the TOOL and MANUFACTURING ENGINEER

Vol. 46
No. 7

June
1961

THIS MONTH'S COVER

Although fluids are used with practically all grinding operations, they are sometimes misapplied. Often a change to a different fluid can greatly increase grinding efficiency at little or no additional cost. The cover shows a typical centerless grinding operation, where a copious flood of fluid is used. An article by grindability researcher L. P. Tarasov, starting on Page 67, describes various types of fluids in detail and gives recommendations for selecting the best fluid for a wide range of conditions.

THE TOOL AND MANUFACTURING ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index*, used generally in libraries. The magazine is available in microfilm form at moderate cost.

Bushings à la carte

Special bushing short orders! All sizes, shapes, types, quantities. American's staff of experienced engineers is ever ready to give help on any special bushing problem. In addition to start-from-scratch designs we stock complete inventories of semi-finished bushings. They are ready to be ground to order and shipped pronto. And American's complete manufacturing facilities assure absolute guaranteed precision on every bushing delivered. It's no accident that American is the world's largest producer of drill jig bushings, both standard and special. Above is an entree of specials we have served customers in the past. What will YOUR order be?

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Productivity and Prosperity

My own company ended 1960 with an unspent balance of five million dollars previously authorized for the purchase of machine tools simply because we could not find the necessary improvement in equipment. That is what Mark W. Cresap, Jr., president of Westinghouse Electric Corp., stated at the company's recent Machine Tool Electrification Forum in Pittsburgh.

How many companies have capital funds awaiting use for the same reason? If equipment were available, it would not take many companies to launch this country upon the greatest wave of economic prosperity that we have ever known. Recognizing the significance of the situation Mr. Cresap continued, saying that this country has a grave shortage of productive capacity—of low-cost, efficient capacity. We need more of this capacity. We can hardly get enough of it. We need to bolster our competitive position in world trade. What could be a more effective way to accomplish that than to increase productivity through improved equipment and better processes?

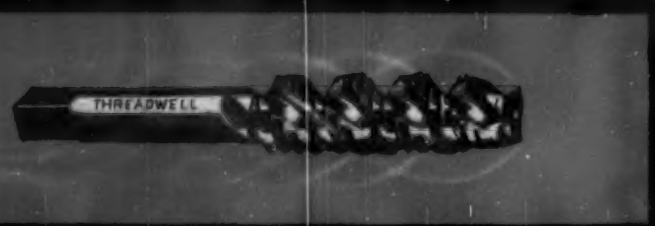
The facts indicate that either Westinghouse has only supermodern machines and equipment or that machine tool manufacturers have been unable to demonstrate that new designs can obsolete present machines. Probably the answer involves a little of each together with the need for searching analyses by engineers. At this time there is no room for lack of imagination or initiative.

Yankee ingenuity has always found better ways to make a better product. There is every indication that, given information and assurances of the needs, manufacturing engineers and designers for the machine tool companies working together will find answers. Adequate communications are of prime importance. Fortunately, we have the world's best. We need only use the channels available. Interchange of information through meetings such as the Westinghouse Forum and ASTME meetings as well as engineering journals such as THE TOOL AND MANUFACTURING ENGINEER should make and keep our productivity the best in the world.

John W Greve

EDITOR

Only TURBO-CUT by Threadwell has a full 3-4 thread plug chamfer!



Benefit? Turbo-Cut's longer chamfer distributes the load over more teeth and breaks up chips to minimize tap breakage. Turbo-Cut's longer chamfer makes tapping easier and cleaner on through holes, does a one-pass job on blind holes. Only Threadwell makes the genuine Turbo-Cut with the longer chamfer.
Also available in bottoming chamfer.

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preview

. . . a fast look at this issue

Scheduling Problems

One of the most commonly asked questions in any plant is "How many hours will be needed to produce *X* number of parts?" Usually, somebody wants an answer in a hurry. Many variables are involved—the type of parts, the number and types of machines involved, to name two. Westinghouse Electric Corp. engineer Roy A. Williams shows how fast answers can be obtained, using just one graph. to which a quickly calculated "production factor" is applied. His article, containing an example, starts on Page 61.

Applying Grinding Fluids

Norton Co.'s Leo Tarasov has devoted many years to the scientific study of the grinding process. His work has resulted in many significant improvements in grinding wheels and, even more important, has contributed greatly to a better understanding of grinding fundamentals. Recently, Dr. Tarasov has turned his attention to grinding fluids. His object: to test the various grinding fluids in use today to find out which types give the best performance under given conditions. The results of this research are summarized in a three-part article that is probably the most comprehensive and valuable treatise on the subject of grinding fluids that has ever been published. Part 1, starting on Page 67 of this issue, covers the characteristics of the fluids themselves. Parts 2 and 3, to appear in the July and August issues, will deal with their intelligent application.

New Generation of Machines

With the advent of automation, a new generation of machine tools is being developed. A lathe described by Robert E. McKee, R. K. LeBlond Machine Tool Co. engineer, has no gearshift or clutch levers on the headstock, no apron length feed handwheel, no crossfeed handwheel, no feed clutch or half-nut levers. All machine motions are controlled from a console—either directly by the operator or by a tape control unit. Both setup and machining are expedited. The article starts on Page 78.

The Plant of Tomorrow

The foundations of the plant of the future are being built today, according to senior associate editor Ted Black. His article, starting on Page 83, takes a look at some current developments that make it possible to predict what the plant of the future will be like—and also to predict what training will be needed for tomorrow's manufacturing engineers.

Better Quality Today

Some of the products that are being designed today call for closer tolerances than can be maintained consistently on existing tracer lathes. The best solution, according to four engineers at the University of California's Lawrence Radiation Laboratory, is to perform a series of lathe checks to pinpoint all sources of inaccuracy, then make appropriate corrections. Part 3 of their article, describing a method for checking slides accuracy with an autocollimator, starts on Page 87.

Computers for Manufacturing

Computers can be used as an integral part of production lines for automatic decision-making and control. Developments in this field are discussed by A. H. Kuhnel, Austin Electronics, in an article starting on Page 95. He shows how a computer is used to control the height of a stack of laminations. The computer selects the correct stock thicknesses to make a stack of the desired height. Another example covers a computer that performs calculations to maintain a constant chip-removal rate when milling turbine blades. Computers, Mr. Kuhnel concludes, are already a useful and important production tool, with a great future potential in manufacturing.

A Productive Year

During 1960-61, ASTME membership soared to a new high and Society programs were of greater service to members—and to American industry—than at any time in the past. Details of this productive year are found in ASTME General Manager Harry Conrad's annual report, page 107.

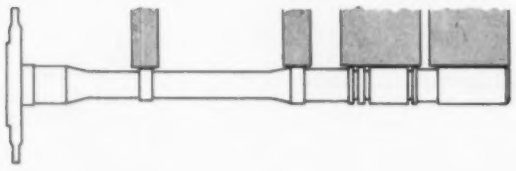
CINCINNATI

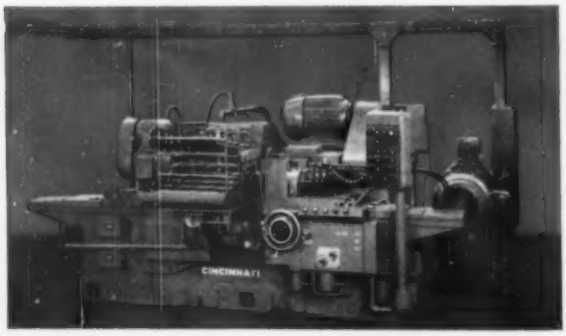
FILMATIC

Automatic Centertype Grinders built by CINCINNATI | GRINDING MACHINE DIVISION

keep the production line ROLLING

Widely spaced diameters are automatically ground on transmission output shafts at a production rate of 92 per 48 minute hour. Drawing below indicates ground diameters. Cincinnati Cost-Cutting Specialists equipped a 10″ x 36″ Plain Hydraulic Grinder for this work.





Completely equipped by Cincinnati Cost-Cutting Specialists for reliable, automatic production of output shafts shown above. The machine is a CINCINNATI FILMATIC 10″ Plain Hydraulic Grinder. Information on standard machines of this type in Catalogs G-660-3 and G-661-2.

It takes considerable ingenuity to automate centertype grinding machines for continuous production duty. But it can be done quite effectively, as shown by the example illustrated here. The machine is a CINCINNATI FILMATIC 10″ x 36″ Plain Hydraulic Grinder, one of hundreds engineered and built for various operations by Cincinnati's Grinding Machine Division.

The machine automatically grinds several diameters on transmission output shafts, using multiple wheels having a 16″ span. Production is at a rate of 92 per 48 minute hour.

Cincinnati cost-engineered Grinding Machines are second to none. You have the industry's widest selection of precision grinding machines; Cincinnati's ACRASIZE Gaging Systems; Cimcool cutting fluids and grinding wheels. May we help in solving your manufacturing engineering problems in the areas of precision grinding? **Grinding Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Better communication of their ideas by engineers is a prime need in the engineering profession, says Chrysler Corp. executive engineer H. R. Steading. He urges that human relations be emphasized in the training of engineers. "Too often the young engineer is so oriented in his own thinking of himself that he is looking only for the engineering problems, whereas most of the problems he will have to solve to be effective are other kinds of problems: the communications problems, the human relations problems, the people problems . . . When he learns to accept the people problems as a legitimate part of his professional functions, then he becomes an effective engineer."

Does automation cause unemployment? No, says Ford vice president Malcolm L. Denise. In testimony before the U.S. House subcommittee on unemployment and labor, Denise pointed out that automation frequently displaces labor, but such displacement is not synonymous with unemployment. According to Denise, the reason for rising unemployment is that the economy is not growing fast enough to provide all the jobs that the growing U.S. population seeks. The supply of labor is increasing faster than the demand. Automation, by creating new industries and by enabling prices to be kept at attractive levels, has actually increased, rather than decreased, employment.

Another Ford executive, Robert T. Ross of the company's industrial relations staff, told the Central Indiana Safety Conference that automation has contributed to greater employee safety. "I don't mean to imply that automation will solve all our safety problems or even most of them," he said. "However, I think that we can do ourselves, our employees and American industry a real service by pointing out the potential for safety that is inherent in automation."

The Machinery and Allied Products Institute has just produced a new filmstrip: A Practical System of Investment Analysis—the MAPI System. The filmstrip is designed for engineeers and executives who have responsibility for providing information for, or for completing or reviewing the analyses on which investment decisions are based. For more information write MAPI, 1200 18th St. N.W., Washington 6, D.C.

Some new developments: The Carpenter Steel Co. is now producing a tool steel that can be heat-treated to tensile strength in excess of 350,000 psi. The steel, known as Hi Shock 60, has unnotched Charpy impact strength of 110 ft-lb at R_C 59 . . . An aluminizing process developed by the Tool Steel Gear & Pinion Co. greatly extends the life of parts subjected to high temperature and corrosive atmospheres. Any iron-bearing alloy can be processed. Costly high-temperature alloys can be replaced by lower-cost aluminized materials . . . Using a bonding technique developed by Vacuum Research Corp., diamond wheels can be given significantly longer life. Stones are bonded under an extremely high vacuum.

Under A-L Quality Control From Melt to Machining

For strong, tough hammered shapes—discs, rings, blocks, sleeves, hubs, collared and shouldered shafts—that give you the most in effective performance, look to Allegheny Ludlum's Forging and Casting Division. Whatever your job requires . . . high resistance to shock or to sudden temperature changes . . . a special alloy . . . stainless . . . or a general purpose steel . . . A-L has both the equipment and billet stocks to give you top service and quick delivery.

Extensive billet stocks enable A-L to save valuable time in processing your orders. Billet stocks include 68 grades of A-L tool steels, 50 grades of Allegheny Stainless, A-L high temperature alloys, and 20 grades of SAE steels. Over 2½ million pounds in stock. And billet stocks can be renewed quickly by shipment from stocks in other Allegheny Ludlum plants.

In addition to providing an extensive billet stock, A-L can help you out of tough spots in other ways. To save you time in emergencies, they'll often forge round, hex, or rectangular bars up to 120 inches long. And when you need just a few pieces or can't wait for the sinking of drop forging dies, A-L hammer craftsmen are often able to turn out your special shapes that resemble drop forgings.

For more information on the characteristics and size range of A-L forgings, refer to FC4, a 28-page technical discussion of A-L's Forging and Casting Division. It also includes information on **Cast-To-Shape** tool steels and **Composite Die** sections. Ask your A-L salesman for a copy, or write: ***Forging and Casting Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan. Address Dept. TE-6.***

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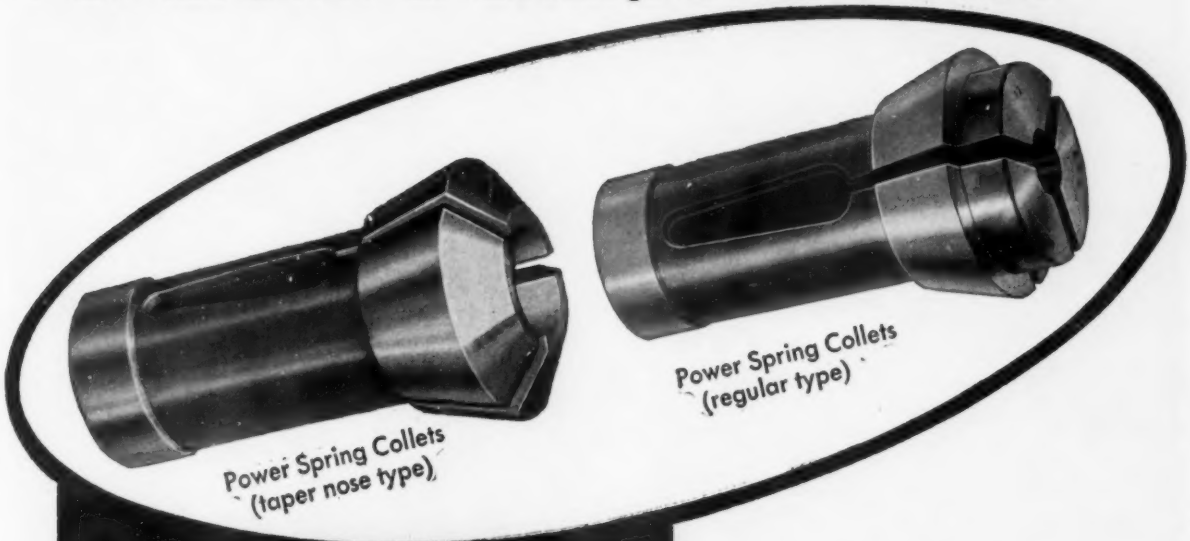
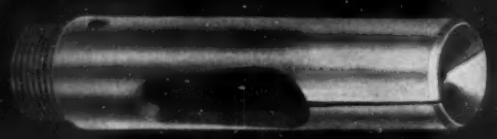
ELMIRA, N.Y.

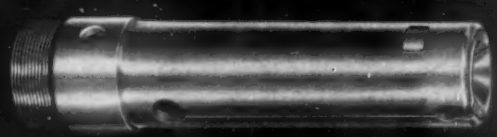
COLLETS and FEED FINGERS

For Brown & Sharpe Machines

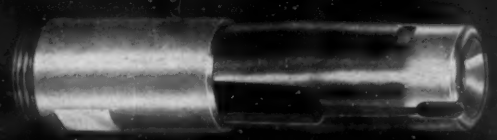




Feed Fingers (regular type)



Master Feed Fingers and Pads



Master Feed Fingers with Adjustable Tension for No. 00, 00G, 0 and 0G Machines.

To get maximum production efficiency from your Brown & Sharpe Machines — specify HARDINGE Collets and Feed Fingers.

Specifically engineered, customer-shop tested and approved for Brown & Sharpe Machines, Hardinge Collets and Feed Fingers will reduce tooling costs and step up production.

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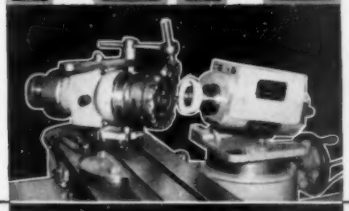
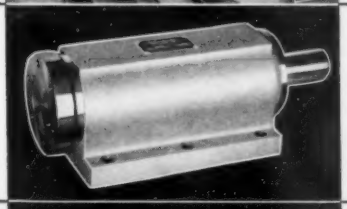
GRINDING



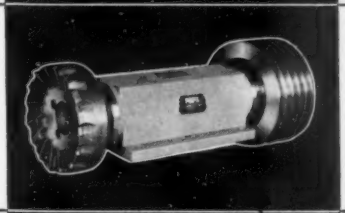
pictured is Pope P-6651-B Motorized Super-Precision Tilting Head for No. 2 Cincinnati Tool and Cutter Grinders. It is but one of hundreds of different Pope Grinding Spindles — motorized, belt driven, external, internal, deep hole, etc.

BORING



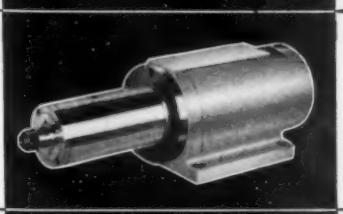
shown is Pope P-18501B Heavy Duty, Flange Nose, Belt Driven Precision Spindle for large deep hole boring and facing tools. Others include multi-spindle boring heads, motorized and motorized-belt driven high speed heads and super-precision heads for boring holes round.

MILLING



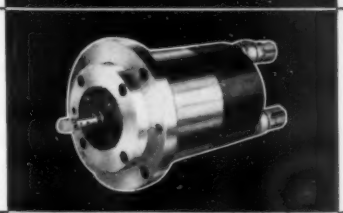
this Pope P-12007-M50 Heavy Duty, Belt Driven Spindle is available in sizes from 1 to 50 HP with standard No. 10, 20, 34, 40, 50 or 60 milling machine noses. (Ask for Bulletin S-17.) Other milling spindles include motor driven, gear hobbing, tracing attachment, right angle and offset types.

GRINDING MILLING DRILLING CUTTING



this Pope P-1029-AU Motorized, Heavy Duty Spindle is available from 900 to 3600 RPM and up to 20 HP. Shaft can be arranged to hold grinding wheels, milling cutters, drills or other cutting tools. Quick-change collet chucks are used for drilling, universal collet chucks for end milling.

HIGH FREQUENCY



this Pope P-940 Motorized, Water Cooled, Oil Mist Lubricated, Grinding Spindle runs at 100,000 RPM, features *low maintenance cost*. Other heavy duty, high cycle Spindles at lower speeds are available for milling and other operations, and for mounting in a horizontal or vertical position.

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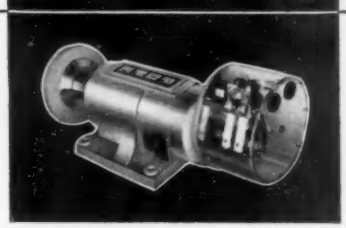

this Pope P-19162-AN Spindle has built-in insulation and rugged fork type cool operating brush assembly for transmitting low voltage high amperage current to wheel. Others include belt driven types and are arranged to operate from 50 to 3000 amps.

One of the 20,000 different Pope Spindles may be just the one you need. May we have your specifications?

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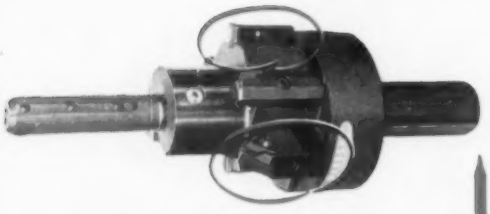
REGRINDABLES or

guaranteed performance makes it easier to decide . . .



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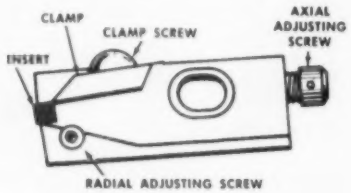
Only 5 basic cartridges (18 options for rake angle and opposite hand) are required to assemble an unlimited variety of single or combination boring, turning and milling tools. Using throw-away inserts and incorporating both radial and axial adjustment, the cartridge fits in a keyway in the bar body or tool block.



Exclusive advantages not possible with any other form of tooling include:

Minimum Holder-Parts-Insert Inventory
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Lowest Tool Cost; No Grinding
Precision Adjustment

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When Wesson recommends tools for your job, they are guaranteed to perform as specified regardless of whichever type tool is best for your application (Wesson makes both regrindables and throw-aways). This performance guarantee is possible because:

1) **Your local Wesson field engineer is an expert in boring, turning and milling with carbides (see examples at right).**
2) **He is prepared to make a thorough, In-Plant Job Analysis of your applications and recommend the best tooling to suit the conditions.**
3) **He follows through to make sure that the tools are installed properly, used properly and perform properly.**
4) **Behind every field man is the extensive experience and facilities of Wesson's 4 specialized tool plants, basic research, application research and tool engineering groups and Wesson's own carbide metals plant.**

A Wesson In-Plant Job Analysis—at no cost to you—enables us to make a sound recommendation based on all the facts. Call your Wesson man in—if he can improve your operations he'll give you a detailed description of how—if he can't improve them . . . he'll tell you that too!

In any case, call him now and ask for your copy of the new 8-page booklet, "How to Bore with Regrindables or Throw-Aways". (Or write us, if you prefer.) This booklet can be of considerable help in planning boring operations.

Wesson Company, 1220 Woodward Heights Blvd., Ferndale 20, Michigan. In Canada: Wesson Cutting Tools Ltd., 93 Judge Road, Toronto 18, Ontario.

WESSON

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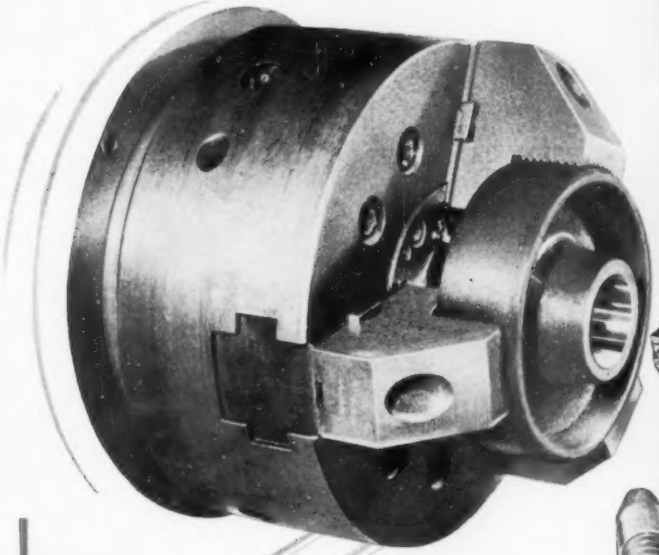
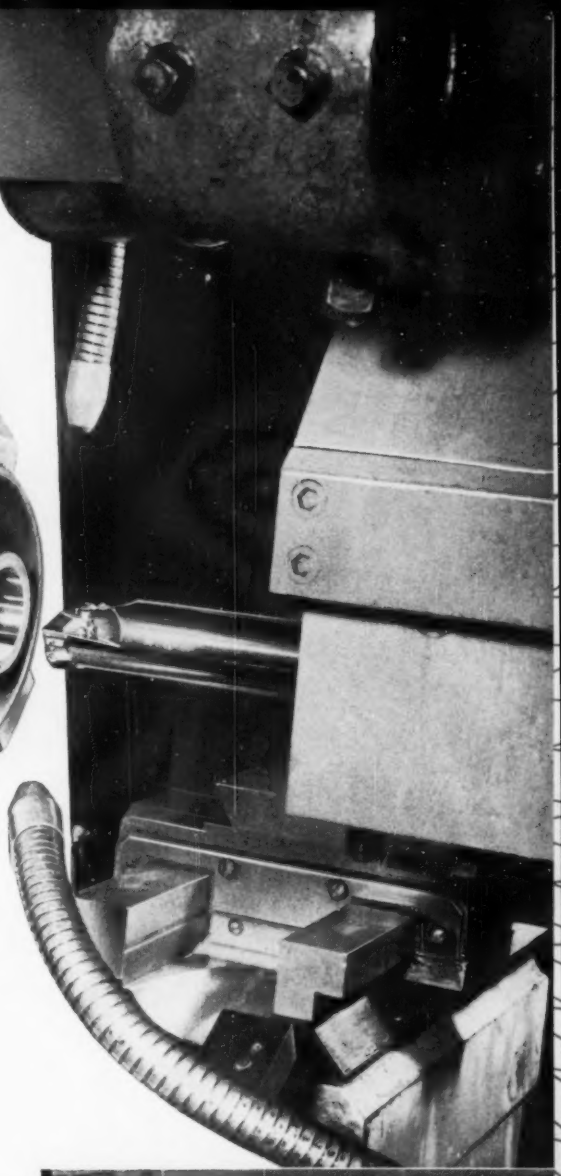
THROW-AWAYS?

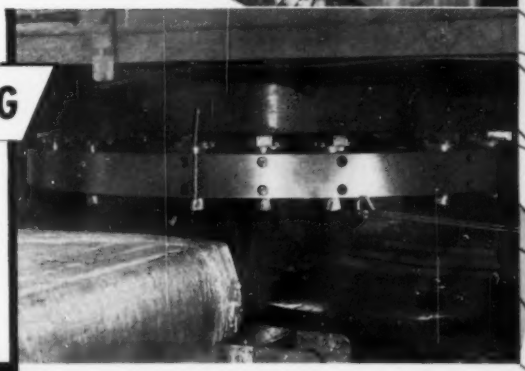




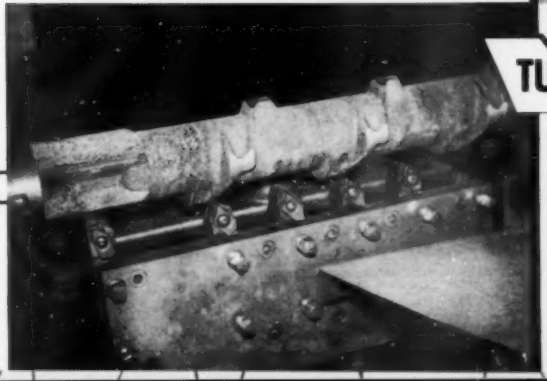
BORING

After failure of all other boring tools tested, this company asked the Wesson field engineer for a job-analysis study. Result: a standard Wesson PAS (positive-rake) boring bar with Wessonmetal WH inserts now bores these hubs at a rate of 160 pieces per insert.

MILLING



Tool life extended from 8-hours to 12-weeks and tool adjustment time reduced from 2-hours to a few minutes . . . that's the Wesson record on this scalping mill. Wessonmetal GI inserts (in locator-anvil units) are micro-adjustable to permit quick setting of face runout.



TURNING

Severely interrupted cuts can impose excessive tool shock loads. A Wesson In-Plant Job-Analysis recommended multiple tools—with successive tools taking identical cuts. Two tool blocks—each with five throw-away insert holders—now turn out 450 pieces per set of inserts.

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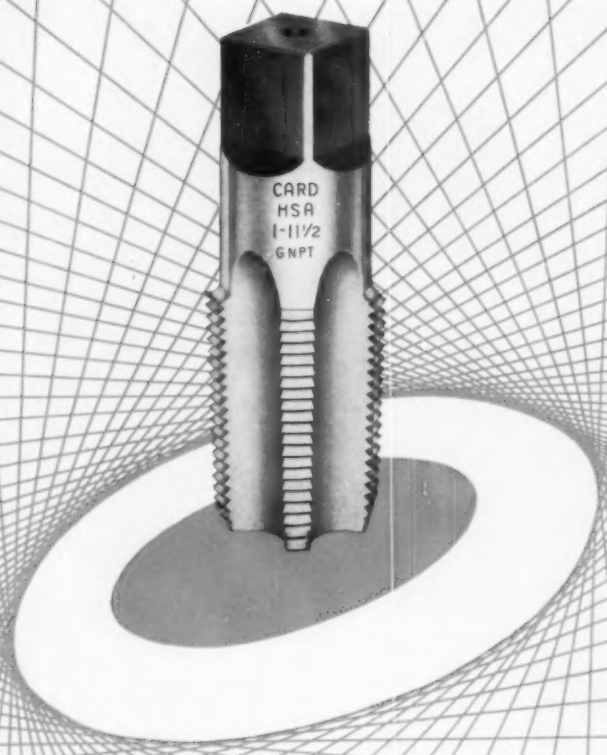
● WESSON CUTTING TOOLS LTD.



CALCULATED TO CUT COSTS

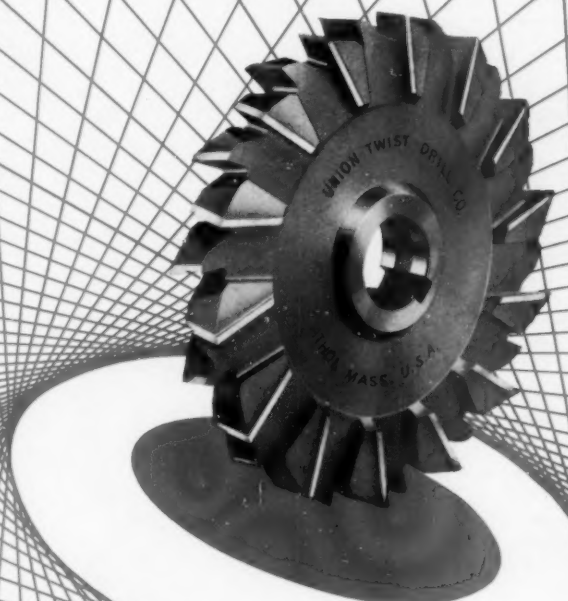
A truly geometric pattern is followed in precisely duplicating each CARD tap, according to type and size. For high volume, high quality production, specify CARD taps. Your CARD Distributor can make fast deliveries of the taps, dies, gages and screw plates you need. For helpful advice on their selection and use, call in your CARD technical man. S. W. CARD DIVISION, Mansfield, Mass.
Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York and San Francisco.

CARD

DIVISION OF UNION TWIST DRILL COMPANY

Serving you through the best distributors from coast to coast

Use Reader Service Card, CIRCLE T4



GEOMETRIC PROGRESSION SYMBOLIZES PRECISE DUPLICATION

CALCULATED TO CUT COSTS

Every UNION cutting tool is duplicated with geometric precision, in each type and size. To your own plant this exact duplication of UNION inserted blade cutters brings most dependable performance, longest service life. Make sure you get these advantages. Specify UNION inserted blade cutters, drills, reamers, milling cutters, end mills, gear cutters, hobs, and carbide tools. Available nationally through UNION Distributors and stocked in UNION warehouses in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City, and San Francisco.

UTD

UNION

UNION TWIST DRILL COMPANY, Athol, Massachusetts

S. W. Card Division, Mansfield, Mass. Butterfield Division, Derby Line, Vt.

Use Reader Service Card, CIRCLE 15

AUTOMATIC, PRECISION DRILLING

EVERY TIME

. . . new Gardner-Denver "Tru-Feed"® drills

Rugged, air-powered Gardner-Denver "Tru-Feed" drilling units drill holes up to 1 ½" in diameter even in hardest metals. Positive mechanical feed assures clean, accurate holes. Precise control of entire operating cycle, and full-power operation at any speed, give smooth, fast performance. Drill's adjustable, rapid advance and sensitive thrust-control features are big cost-savers in production drilling. Available in either portable or stationary models.

Automatic operation—Just push a button to start cycle. When hole is drilled, tool retracts and automatically shuts off.

Adjustable stroke—Set two stops to utilize any portion of stroke. Front stop controls hole depth to within .005".

Portable or stationary—For stationary applications, use mounting brackets or drill bushing tips. In portable use, a simple drill bushing fixture lets you move drill from hole to hole. "Tru-Thread"® tapper used in same tooling maintains concentricity between drilled hole and tap.

Adaptable to Automation—Start and stop poppets may be replaced with adapters for remote operation. Pressure-type poppets may be used. A pressure signal is built-in to control sequence of indexing and clamping fixtures.

Powerful and versatile—Compact, heavy-duty air motors develop up to 1½ hp.—provide dependable power for hard-metal drilling, gun-drilling, reaming, boring, counterboring, countersinking and other production operations at speeds from 75 to 4400 rpm, and feeds from .0005" to .0145" per revolution.

For details, request bulletins 93 and 96 on Gardner-Denver automatic drilling and tapping equipment.

Companion Tools for Precision Tapping. "Tru-Thread" tappers, incorporating a lead screw, assure precision-tapped holes of the highest quality in hard or soft metals. Portability provides accurate, economical tapping of holes in any workpiece—eliminating the need to move it to a machine tool.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois—Offices in principal U. S., Canadian and Mexican cities.
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario.
International: Gardner-Denver International Division, 233 Broadway, New York 7, N. Y.

International Offices: Buenos Aires, Argentina; Artarmon, N.S.W., Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola, N. Rhodesia; Salisbury, S. Rhodesia; Johannesburg, Transvaal.

Use Reader Service Card, CIRCLE 16

Use Reader Service Card, CIRCLE 17

General Electric announces

Carb-O-Lock

the single, most important advance in the whole history of disposable tooling!

Revolutionary... toolholder-insert combination cuts tool costs up to 40%

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30%
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40%
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It's

Revolutionary... toolholder-insert combination cuts tool costs up to 40%

ew
arb-O-Lock toolholder-
nsert combination
ffers unheard of savings...
0% and more
hen you buy it!

0% and more per cutting
dge when you use it!

stonishingly simple
design; so easy to use.
's new...it's Carb-O-Lock!

Think of it! Now you can cut your disposable tooling costs by up to 40%! This revolutionary Carb-O-Lock toolholder-insert combination costs 30% less to buy than ordinary toolholders . . . costs 40% less to use. You save and keep on saving, because savings are designed right into the new Carb-O-Lock toolholder-insert combination.

The Carb-O-Lock is truly unique in toolholder design. *Simplicity* is the key! Carb-O-Lock employs just *three* parts (not including insert) — compared with up to 12 parts in other toolholders. Using a cam-action locking principle, the Carb-O-Lock toolholder makes insert changing and indexing a breeze . . . easy as one, two, three! And the streamlined design of this revolutionary toolholder lets you bring it closer to the work, with unrestricted chip flow. No clamps . . . no "clubheads" . . . no complex mechanisms.

HANDLES MOST OF THE FOLLOWING MACHINING JOBS

Carb-O-Lock toolholders are available right now in toolholder shank sizes from ½" square to 2" square for square inserts and ½" to 1½" on toolholders for triangular inserts to be *used profitably in your shop.* The specially processed close-tolerance, disposable inserts have been developed in Carboloy® Grade 883 for machining cast iron as well as many operations on the following materials: high-temperature alloys, type 300 stainless steel, brass, and bronze.

Look over the features on the next page. See just how this brand new toolholder-insert combination can mean big savings in *your* metalcutting operation. Phone your Authorized Carboloy Distributor and place your order. Then use Carb-O-Lock — designed to bring you even *better profits through better tooling.*

Great! . . . *revolutionary!*

Metallurgical Products Department of General Electric Company, 11173 E. 8 Mile Avenue, Detroit 32, Michigan.

CARBOLOY®
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMOND • MAGNETIC MATERIALS
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

Simplicity is the key

Check these features...

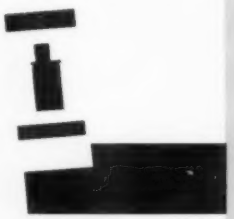
The all-new Carb-O-Lock toolholder-insert combination was developed for just one reason: To reduce your present machining costs. Can it? Yes. Here's why . . . and how.

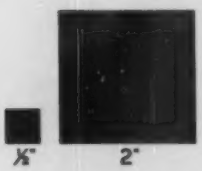
LOW, LOW SILHOUETTE

No "clubheads," clamps, or screws sticking up to take up space or interfere with the chip flow – not even on the smallest size (½" square shank) Carb-O-Lock. Nothing to wash off or wear away.

FEWER PARTS

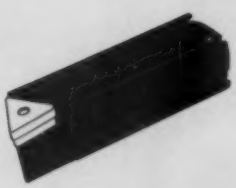
Carb-O-Lock employs just three parts (not including insert): Hard-tough cam pin, Carboloy carbide seat, heat-treated shank. Results–decreased parts inventory, absolute minimum possibility of part failure, greatly reduced downtime, lower replacement-part cost, and lower over-all cost.





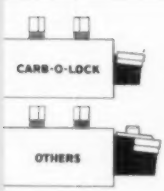
PICK THE ONE YOU NEED

Carb-O-Lock comes in 15 styles, 124 sizes for triangular and square inserts. Shank sizes from ½" square (use it to replace your brazed tooling, too!) to 2" square.



LOOK . . . NO POCKET!

Carb-O-Lock gives you larger end-cutting edge angle because no pocket is needed to retain insert. Can often be used on many tracer applications with limitations on plunge angle.



REDUCED OVERHANG

Reduces space requirements for locking mechanism–less deflection and vibration. This means less insert chipping and breaking, for longer, more consistent tool life.

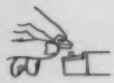
TOUGHER

The cam pin in the Carb-O-Lock is a high-alloy bearing steel. Has not broken under the severest use. Cam action forces insert against shank, so insert stays locked in place until *you* loosen it. Cam pin is adjusted from underneath. Self-cleaning, self-locating wrench socket . . . never clogs . . . makes indexing and changing of inserts a breeze.

ONE-TWO-THREE INDEXING

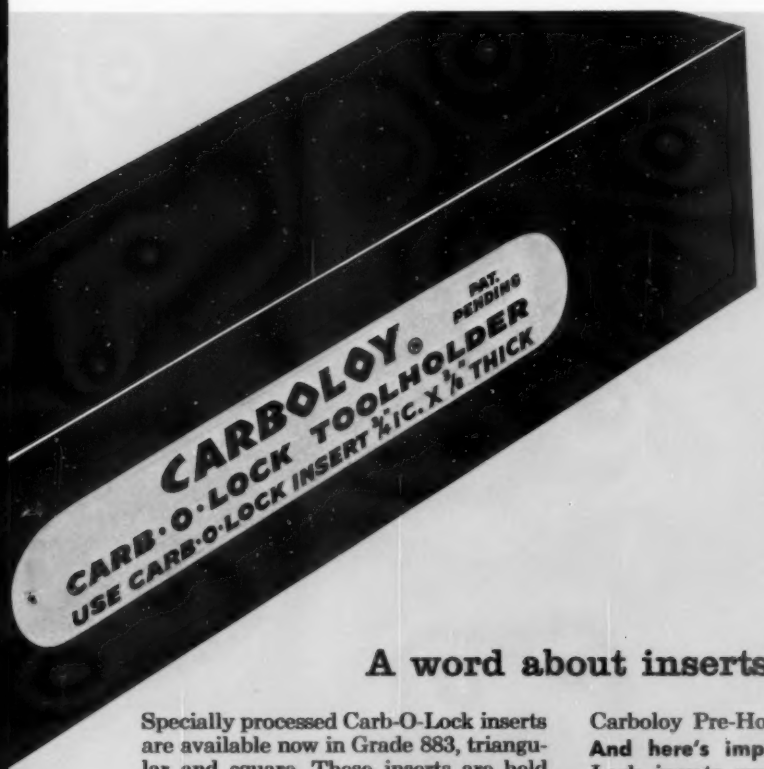
THIS ✓ IS ALL YOU NEED. JUST TWIST,

REPLACE OR INDEX INSERT,



TWIST.

to the new Carb-O-Lock



NOTE TO SPECIALIZED SHOPS

We can't overstress the importance of the Carb-O-Lock toolholder-insert combination to those who are *not* using carbide disposable tooling in their machining operations. Up until now, if you wanted to use disposable-insert carbide tooling, the cost of the toolholders may have represented an investment that was larger than you cared to make.

Not so now. No longer must you settle for second best. Because the new Carb-O-Lock fits easily into your tooling budget. Now you can have the quality of carbide tooling at the lowest cost ever – even lower than your present tooling. And the broad range and sizes give you the flexibility that makes carbide tooling on small-lot jobs economical. Check into it . . . and see!

A word about inserts

Specially processed Carb-O-Lock inserts are available now in Grade 883, triangular and square. These inserts are held to tolerances of ± .002" on ¼" I.C. to ± .004" on the 1" Sq.. They cost 40% less than some precision-ground (± .001") inserts.

These inserts have cutting edges composed of whole carbide crystals which are stress free, and notch free like Carboloy Pre-Honed inserts.

And here's important news. Carb-O-Lock inserts are designed to fit most square or triangular negative rake toolholders you may now be using. This means that while you are changing your operation over to Carb-O-Lock, you can begin by buying the new inserts. Then, as you replace your present toolholders, just order the new Carb-O-Lock. Simple.

. . . and about packaging

Carb-O-Lock inserts come skin-packed on a color-coded card with complete identification which fits in a standard 3" x 5" file drawer for easier storage and inventory, faster identification, simpler handling.

Carb-O-Lock Grade 883 inserts are skin-packed — five or ten to a card depending on size. This means: Easier inventorying • Chipping is eliminated • No surface contamination from handling • Color-coded grade identification • Cards fit standard-size filing cabinet.

Your Authorized Carboloy Distributor can supply you with the new Carb-O-Lock inserts in Grade 883 now. Call him today.

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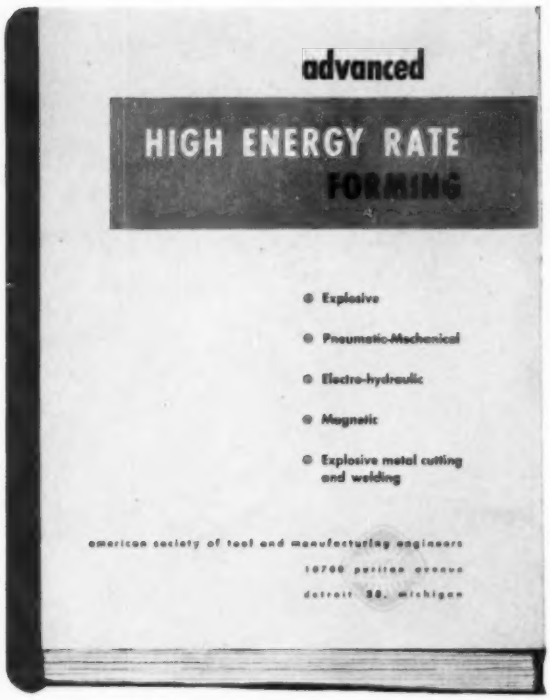
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

ACT NOW!
YOUR SAVINGS BEGIN WITH CARB-O-LOCK!

ASTME Special Publication



HIGH ENERGY for PRODUCTION

"Advanced High Energy Rate Forming" contains* over 20 current technical reports and case studies of HERF systems. This ASTME special publication has been produced to bridge the "technical gap" in the HERF field. Today's rapid break-throughs in HERF production applications and research progress are reported in "Advanced High Energy Rate Forming".

**the publication also includes an up-to-date HERF bibliography.*

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Use Reader Service Card, CIRCLE 21

Using basic components, seven different arrangements are possible, as shown above. Spindle drive motors can be mounted at right, left, or on both sides with single or double spindles; two machines can be placed side-by-side or used with other production machines.

The 4 BIG Features of Ex-Cell-O's New 411 Vertical Are Important To You

1. QUICK TOOL CHANGING—Tool changing and adjusting is fast and easy because of "clean" design and placement of the Model 411's components.

2. EASY PARTS HANDLING—Vertical construction lends itself to safe, easy loading and unloading of parts in a wide variety of shapes and sizes.

3. SINGLE COLUMN CONSTRUCTION—Solid base-column gives firm support to the hydraulically-operated compound tool slide. Rugged, simple construction assures maximum accuracy and efficiency, plus long life with lowest maintenance.

4. PRODUCTION VERSATILITY-The all-new Model 411 performs turning, boring, facing, grooving, limited contouring and chamfering operations singly or in combination. Often, both sides of disc-type parts can be machined simultaneously.

Contact your Ex-Cell-O Representative or write direct for details.

61-60M

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

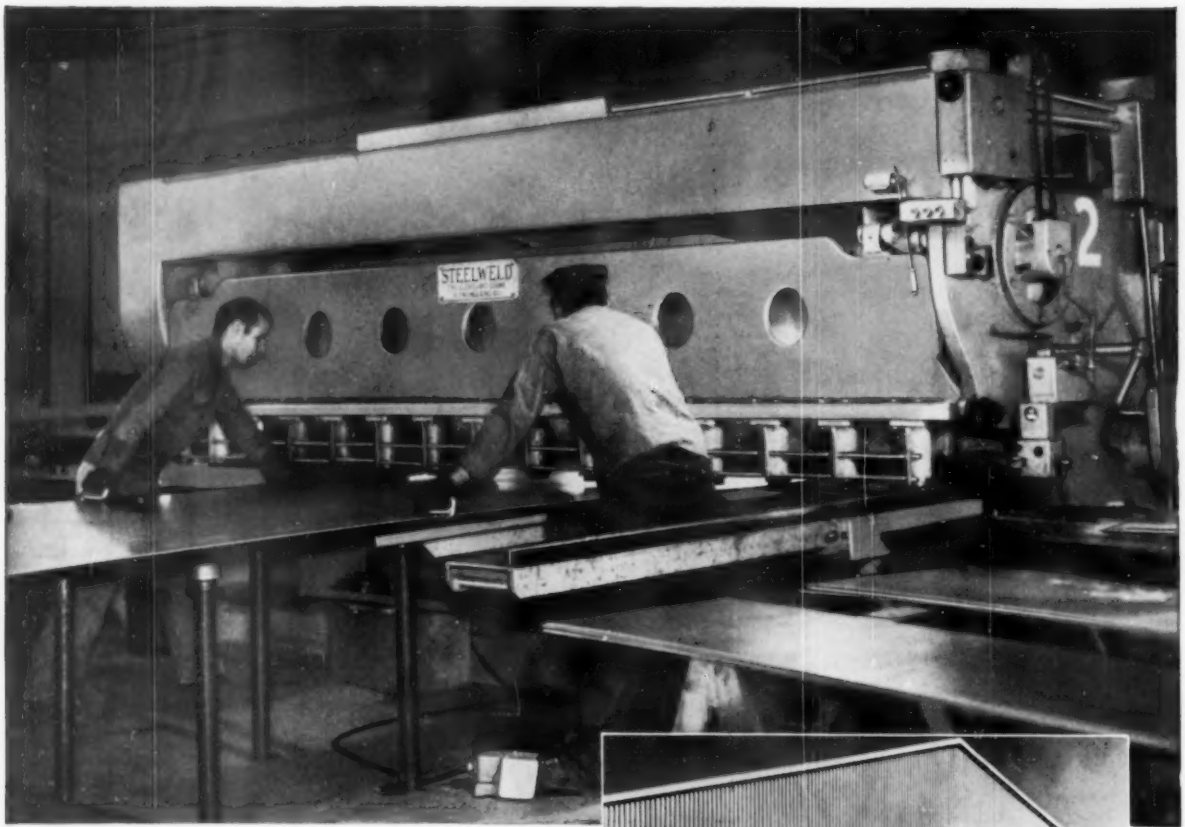
Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

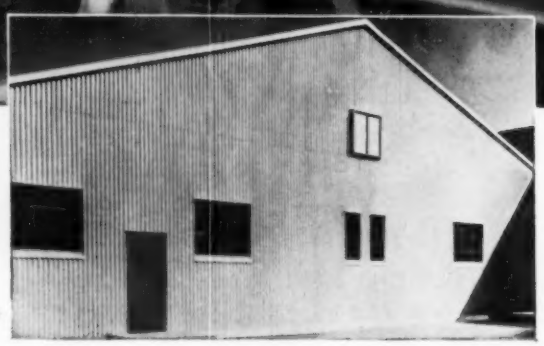
STEELWELD SHEAR

Operates 16 Hours a Day

Cuts Components for Prefabricated Buildings



Cutting and slitting operations normally keep this Steelweld Shear busy 16 hours a day. It is equipped with Steelweld's popular Micro-Set Knife Adjustment. This permits adjusting the knife clearance to suit the thickness of metal being cut in the matter of seconds. Thus, the finest cuts are assured for every shearing job.



A recent Pascoe Building.

RAPIDLY forging ahead in the prefabricated steel building field, Pascoe Steel Corporation, Pomona, California, has found its Steelweld Shear to be an extremely important factor in maintaining a steady rate of production. A large amount of shearing is required to fabricate several hundred tons of steel per month.

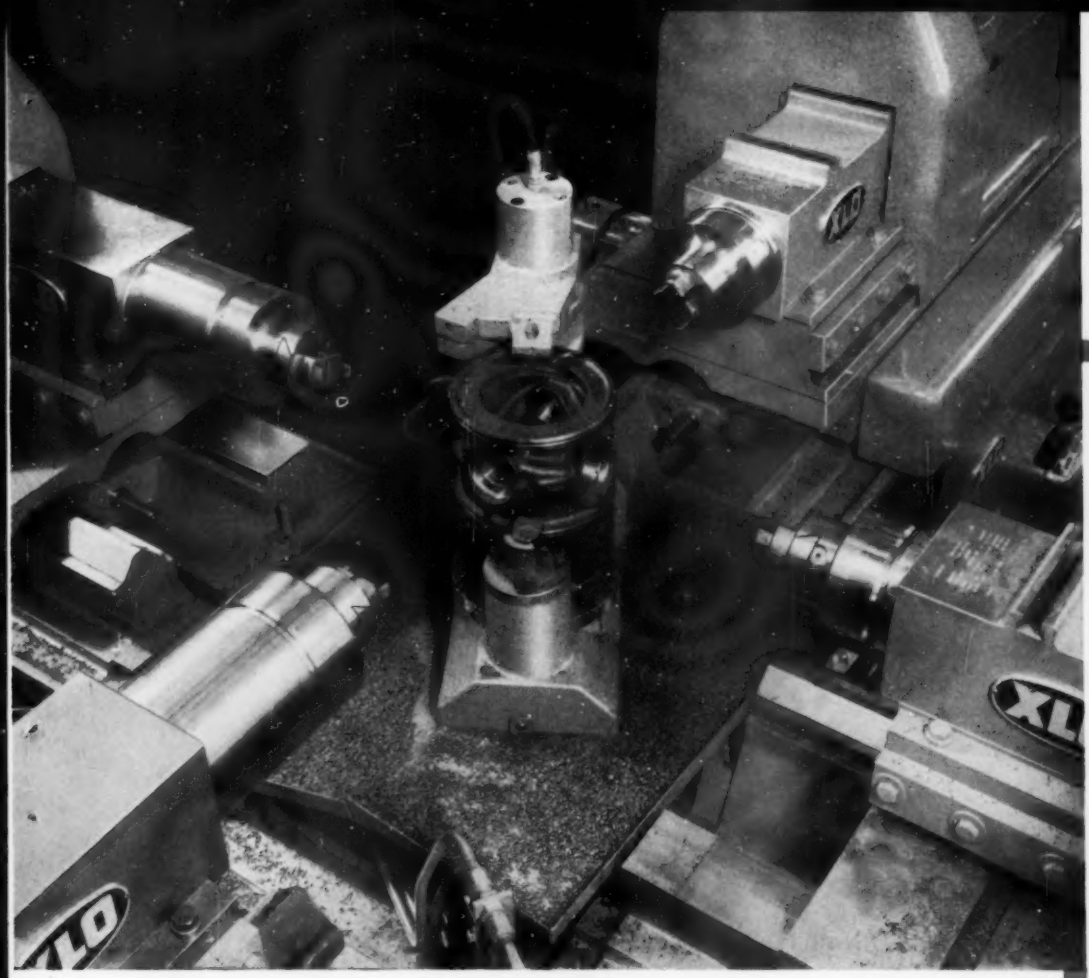
The Shear is normally operated 16 hours a day. It is used for cutting web plates for building columns, rafters and many other building components. About 20 hours a week it is used for slitting. The machine has functioned with very little maintenance. In nearly three years of service, the clutch has never required adjustment.

Write for free copy of catalog No. 2011

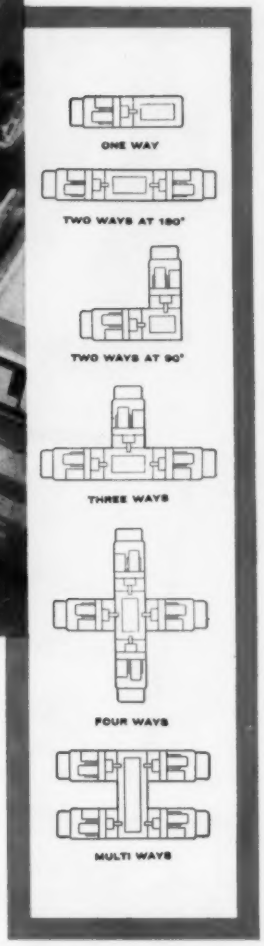
STEELWELD SHEARS PIVOTED BLADE

Steelweld Machinery includes: Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

STEELWELD MACHINERY DIVISION • THE CLEVELAND CRANE & ENGINEERING COMPANY • 8559 EAST 282nd STREET • WICKLIFFE, OHIO



TYPICAL
"BUILDING BLOCK"
ARRANGEMENT



4-Way Production Savings with Ex-Cell-O Way Machines

1 **LOWER COST** Each Ex-Cell-O "Building Block" Way Machine Unit has standard base, table slide and complete, inbuilt hydraulic system. You can specify only the standard spindles or accessories that meet your present needs. 2 **INCREASED FLEXIBILITY** One Way-type unit gives you a basic, versatile precision boring machine; as operations become more complex, simply add one or more Way units to a common end section to multiply production or machining functions. 3 **MORE VERSATILITY** Ex-Cell-O Way Machines permit precision boring, turning, facing or grooving, chamfering or counterboring—with or without automatic cycles, work indexing or clamping. 4 **GREATER CAPACITY** Using simple fixtures, you can rough or finish-machine larger, heavier work than possible on most standard boring machines.

Ask your Ex-Cell-O Representative about savings with Way-type Machines, or write direct for details.

Typical setup shows four units positioned at 90° for simultaneous rough boring, counterboring and trepanning. Beds, tables, center section, hydraulic systems, controls and Ex-Cell-O Precision Spindles are standard components. Units can be rearranged at any time.

60-29

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Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

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Ex-Cell-O Drill Jig Bushings

Uniform Hardness, Uniform Quality in More Than 11,000 Cataloged Bushings for metal or plastic jigs!

In stock now from coast to coast, Ex-Cell-O Drill Jig Bushings are made from the finest chrome-alloy bearing steel, precision-ground inside, outside and under the head. Steel bushings are held to consistent 62-64 Rockwell C Hole hardness.

Ex-Cell-O carbide bushings are made from the finest material available.

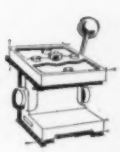
Select from one of the largest inventories in the U. S.

FREE DATA—See your local Ex-Cell-O Representative or Distributor for catalogs and bulletins on Drill Jig Bushings and other jig and fixture cost-cutters. Or contact Ex-Cell-O direct: Phone TOwnsend 8-3900; TWX—DE 876; Wire ZTC.

COMPONENTS FOR ALL YOUR JIG AND FIXTURE NEEDS—AVAILABLE IMMEDIATELY FROM A SINGLE, RELIABLE SOURCE!

Fixture Components—Clamp assemblies and fixture details.

Lift-Swing Fixtures—For fast drilling of difficult holes.



Micron Sections—Cast-iron shapes precut to your needs.

Reader Service Card Number is for Drill Jig Bushing Literature only. Request literature on above items separately.

61-18 BU

EX-CELL-O FOR PRECISION

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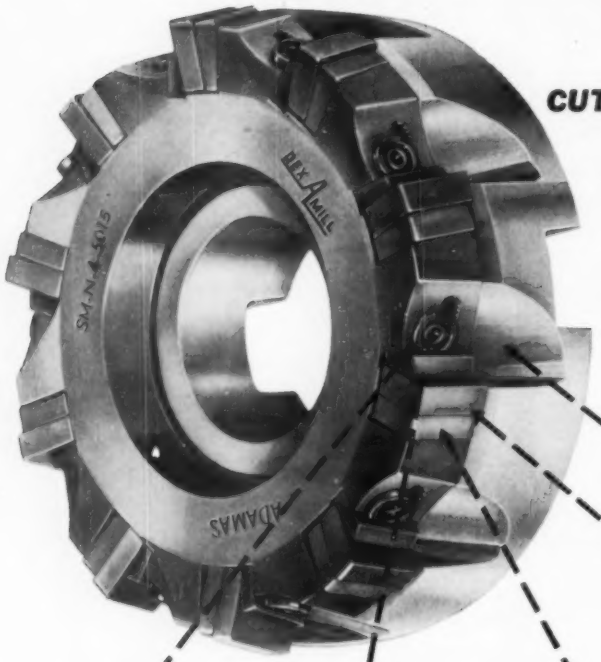
Bushing Sales Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Introducing DEX A MILL

...THE NEW INDEXABLE MILLING CUTTER BY ADAMAS THAT GIVES YOU:

- **GREATER ACCURACY to produce finer finishes**
- **MORE TEETH to remove more metal**
- **SUPERIOR DESIGN to give longer carbide life**



POSITIVE LOCK

Adamas Dex-A-Mill features the powerful combination of positive lock on top and carbide anvil under carbide insert. Securely locks, easily unlocks with a partial turn of a wrench.

CARBIDE CHIP DEFLECTOR

Protects cutter body from chip erosion—Chips strike long-wearing carbide deflector instead of body or locking mechanism.

THICK CARBIDE ANVIL

For maximum rigidity and insert support . . . permits higher feeds and speeds . . . protects cutter body from damage.

THROWAWAY CARBIDE INSERTS

Inserts are quickly and accurately indexed or replaced on the machine with the cutter in position. Eight individual cutting edges on each insert eliminate costly regrinding.

WIDE, DEEP CHIP SPACE

Allows maximum metal removal—permits heavier cuts . . . Eliminates possible damage to cutter due to loading of chips.

Greater accuracy is built-into the rugged, heat-treated alloy steel body of this top performing milling cutter for throwaway inserts. Its 2-piece construction enables insert seats to be uniformly ground to extremely close tolerances assuring consistently superior performance. DEX-A-MILL's greater number of teeth per cutter diameter permit fast, low-cost milling operations with inexpensive, indexable, throwaway carbide inserts. Right and left hand cutters are stocked in both shell end mill and face mill designs with double negative rake angles and 15° lead angle. Standard size diameters range from 3" to 12" . . . Special cutters subject to quotation.

● *For full details, write for your copy of Bulletin DM-860.*

Producers of:
Tungsten Carbide Tools
Tool Tips
Dies, Wear Parts
Dex-A-Tool
Dex-A-Mill

ADAMAS CARBIDE CORPORATION
KENILWORTH, NEW JERSEY

PROGRESSIVE CARBIDE USERS SELECT BY *Performance*...NOT HABIT!

with THE BRUSH SURFINDICATOR "meeting specs" is just part of the pay-off...

An Ohio missile-parts maker* knows why. His Surfindicator not only eliminates surface rejects but also cuts machine downtime 60%. Quick, accurate tool checks . . . at his machines . . . insure optimum tool changes to greatly extend productive tool life. *Anyone, anywhere* can measure *any* finish from 1 to 1000 microinches with a compact, portable Surfindicator. Choose the standard model or the ultimate in portability, the new battery powered, completely self-contained, 5½ lb. MS-1000. Ask your nearest Brush distributor for a demonstration. *Write for our new booklet . . . 16 pages on how Surfindicator improves profits in five major operating areas . . . production, tooling, engineering, quality control and research.* *name on request

brush INSTRUMENTS
DIVISION OF
37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

let's talk CAPACITY

CAPACITY, what does this represent in terms of dollars to a prospective buyer of metal cutting machines.

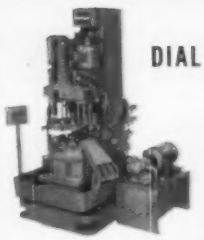
We at **MICHIGAN** feel that manufacturing **CAPACITY** is an important asset and most beneficial time saving aid available. We constantly strive to improve our manufacturing and assembly methods, this in turn increases our **CAPACITY.** The ability to manufacture machines in less time, results in a low product cost to the customer.

- Modern Building.
- Excellent plant facilities.
- Complete engineering.
- National sales staff.
- Blueprint and duplicating departments.
- Manufacturing facilities to machine every detail in all of our many components.
- **MICHIGAN** designs and fabricates electrical, hydraulic and lubrication installations.

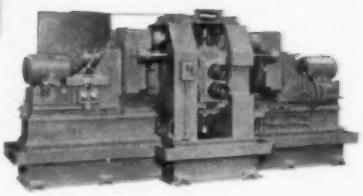
All this represents **CAPACITY.**

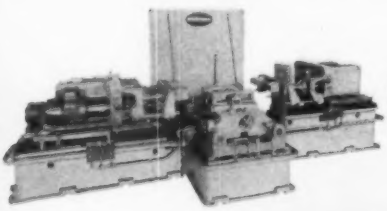
MICHIGAN'S CAPACITY pays off in savings to our customers. If you're looking for a special metal cutting machine of any kind, remember **MICHIGAN**—we specialize in dependable delivery, low product cost and excellent service. Send us your inquiries, we will be pleased to serve you promptly.

DIAL



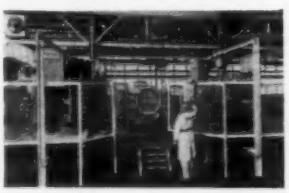
TRUNNION

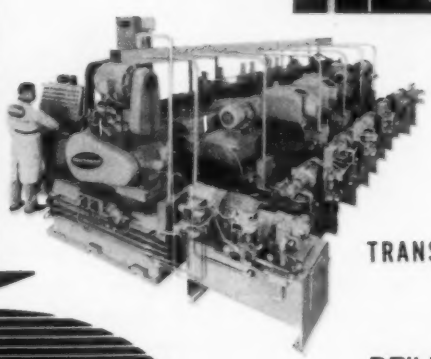




SHUTTLE

SPECIAL





TRANSFER

TRANSFER
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TRUNNION
SHUTTLE
GUN DRILLING
TAPE CONTROL
DRILL HEADS
FIXTURES

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SPECIAL MACHINE CO.

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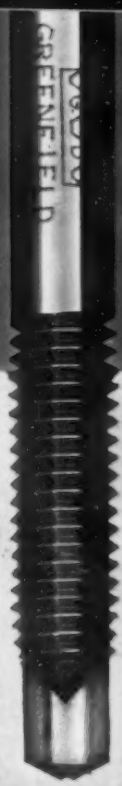
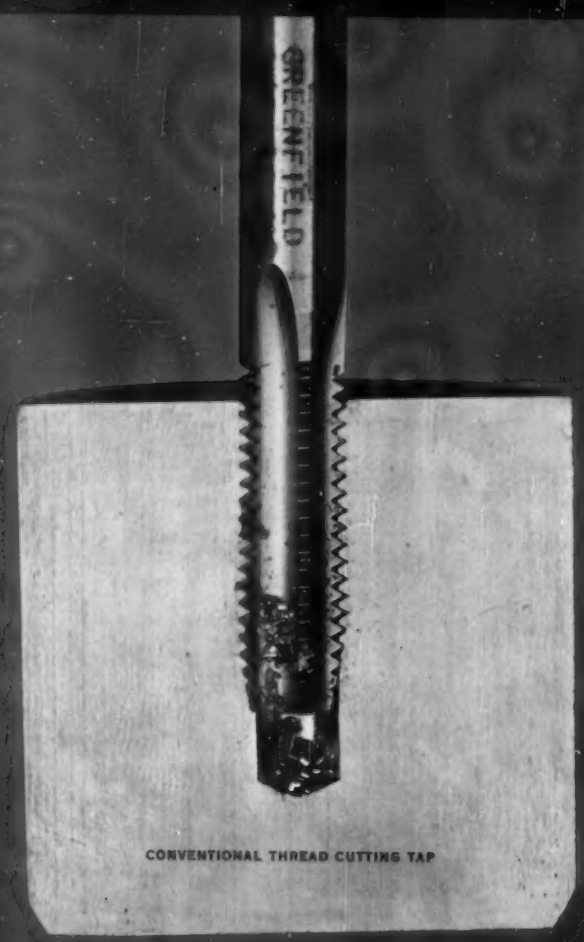
LOOK MAN..NO CHIPS!

With Tru-Lede Fluteless Taps

PATENT NO. RE24572





CONVENTIONAL THREAD CUTTING TAP

How can a tap be a tap and not generate chips? Simple enough, it cold forms threads by pressure, instead of cutting away metal.

Naturally this method does not work equally well under all conditions and with all materials, but in ductile and free machining materials it is giving exceptional results on innumerable applications.

Faster, cleaner, stronger, here is a new concept in tapping. Sizes #0 to ½" NC and NF.

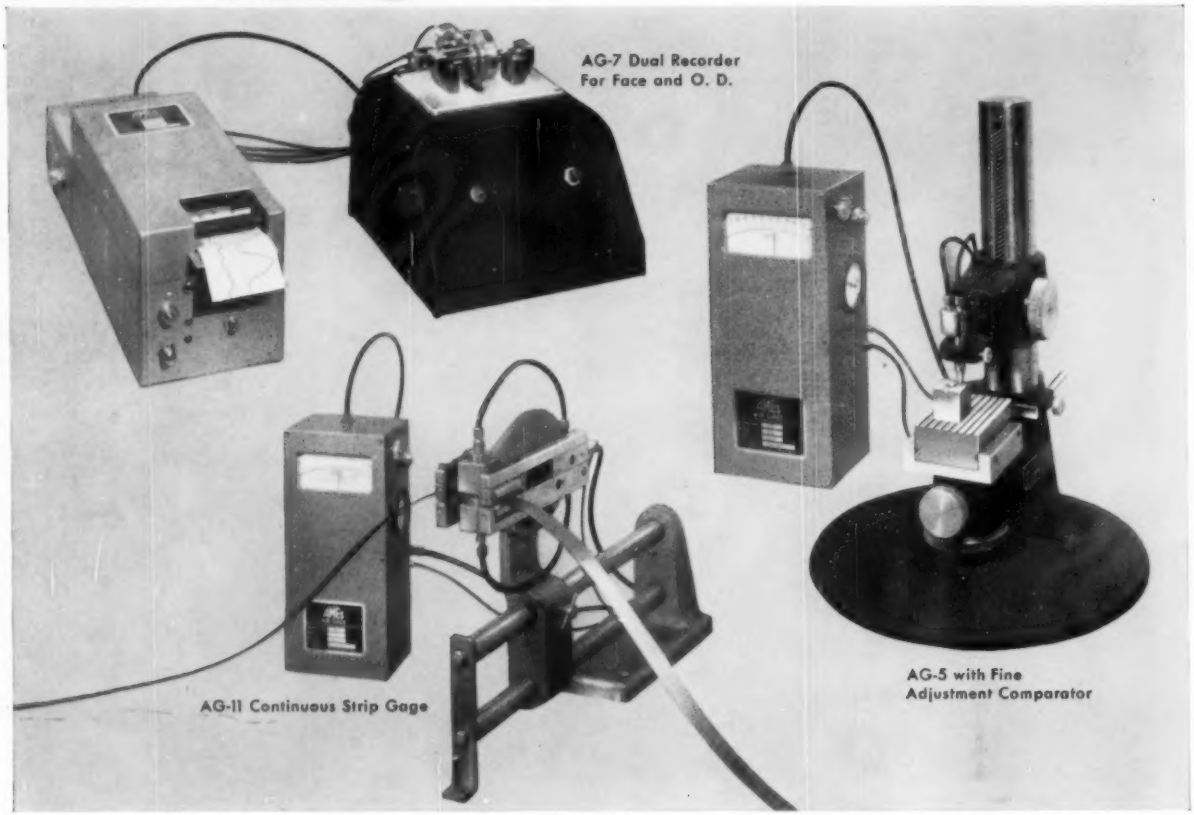
Contact your nearest GREENFIELD Distributor for the complete story on Tru-Lede Taps. Better still, he has them in stock, try a test run. You may be amazed, as others have been.

INDUSTRIAL DISTRIBUTOR
SERVING INDUSTRY ECONOMICALLY
THE RIGHT HAND OF PRODUCTION

GREENFIELD TAP & DIE

GREENFIELD, MASSACHUSETTS

AMES *Masters of Measurement*



ACCU-FLOW AIR GAGING EQUIPMENT

The new line of ACCU-FLOW air gages developed by B. C. Ames includes several patented components, including nozzles and pressure indicators, which give these gages unusual range and exceptional linearity.

Special Models are Available for Checking: outside and inside diameters, center distances, flatness, roundness, hole depths and continuous non-contact measuring or comparing of paper, metals, plastic films, etc.

Ames ACCU-FLOW Air Gages are providing the answer to many measuring problems that were once considered impossible to solve. For complete information on the entire line of Ames air gaging equipment, write for new ACCU-FLOW folder. *You're asking for the best when you specify Ames!*

B. C. AMES CO., Waltham 54, Mass. Representatives in Principal Cities — In Canada, H. C. Burton Co., 166 Rebecca Street, Hamilton.

B.C. AMES CO.

MANUFACTURERS OF MICROMETER DIAL INDICATORS, DIAL GAUGES, ACCU-FLOW AIR GAGES, PORTABLE TRANSISTORIZED COMPARATORS

Bendix SYSTEM-ENGINEERED Numerical Controls log 450,000 hours—with less than 5% downtime

The impressive number of hours logged by machines operated by Bendix® numerical control systems is just one index of leadership in the new era of metalworking. Even more significant is the downtime record. Reports from 30 users show that downtime ranged from 1% to 10%, with an average of slightly less than 5%. Persuasive figures on the practicability of Bendix numerical control systems.

Bendix training and service contribute markedly to maximum machine utilization. Immediately prior to delivery of the machine tool, Bendix trains user personnel who will supervise, operate, and maintain the equipment. When the machine tool is installed, Bendix field men aid in the initial set-up. To assure quality service, Bendix maintains a competent field organization in branch offices throughout the country.

Bendix works closely with machine tool builders. And our numerical controls are *system engineered* to specific applications. Case histories prove that Bendix controlled systems cut production costs, reduce lead time, increase machine tool efficiency, and make parts of consistently high accuracy.

When you consider numerical controls—feasibility, installation, operation—call on Bendix. Investigate our complete line of control systems, both contouring and positioning. Let us explain our proved design techniques, including modular construction, transistorized plug-in circuitry, linear and rotary feedback devices, and high performance servo devices. Find out how Bendix can help you make new profits in metalworking. Write today.

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Industrial Controls Section

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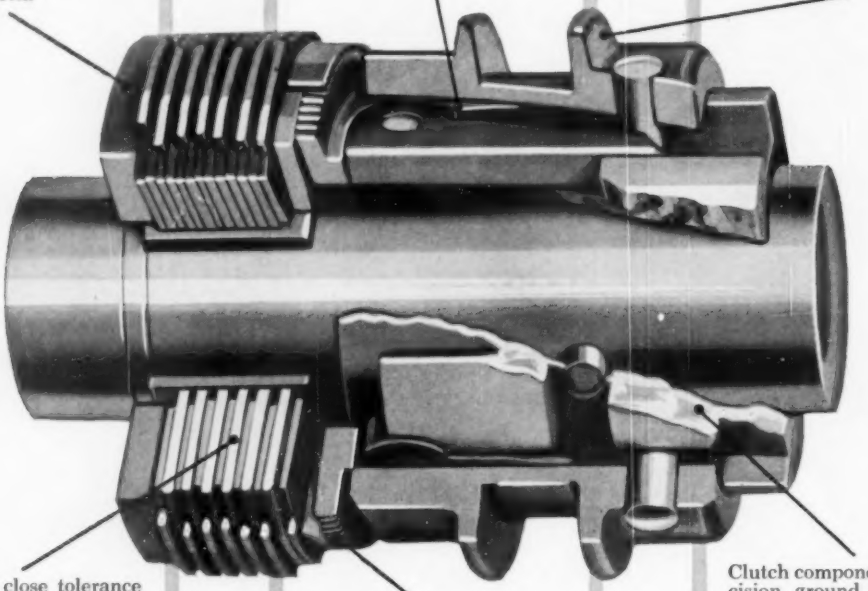
Symmetrical design and precision machining assure smooth clutch operation. Torque is not affected by centrifugal force or direction of rotation.

Low axial pressure to levers gives positive, instantaneous engagement. High-ratio levers are case hardened forged steel. Immediate disengagement.

Use any actuation device — air, manual or electric. Slight pressure to shifting spool engages clutch. Spool length prevents binding and gives longer life.



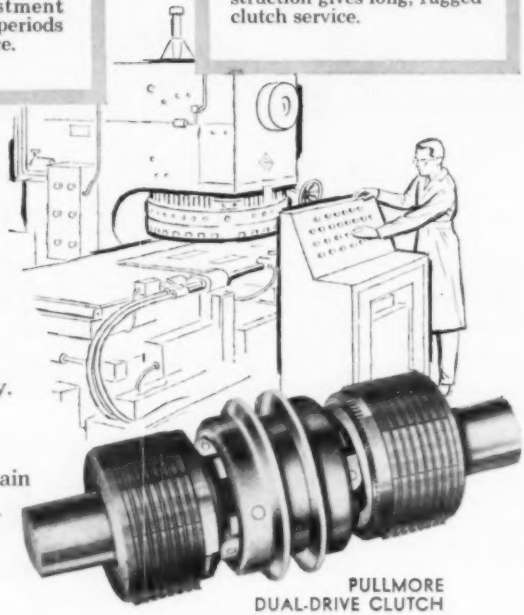
Discs meet close tolerance flatness checks. Heat treated steel, graphite-impregnated bronze, sintered bronze or molded discs for oil and dry operation.

Easy Adjustment... simply raise locking spring and turn collar. Adjustment lasts for extra-long periods of heavy-duty service.

Clutch components are precision ground and highly concentric. Locking split ring assures positive axial positioning. Strong construction gives long, rugged clutch service.

Increase production with Pullmore Clutches

Modern, high-production machines depend on efficient clutch controls. Today's clutches must be versatile, must provide fast but smooth actuation, must transmit full power and must be designed for enduring controllability. Rockford Pullmore Clutches meet these requirements. They start, stop, reverse, shift, inch, cycle and idle. Pullmore dual-drive clutches drive forward and reverse, obtain high and low speeds, or control as clutch-brake combinations. Engagement is fast, smooth and positive. The high torque, compact clutches handle loads from 126 to 11,000 inch lbs. Write for illustrated brochure.



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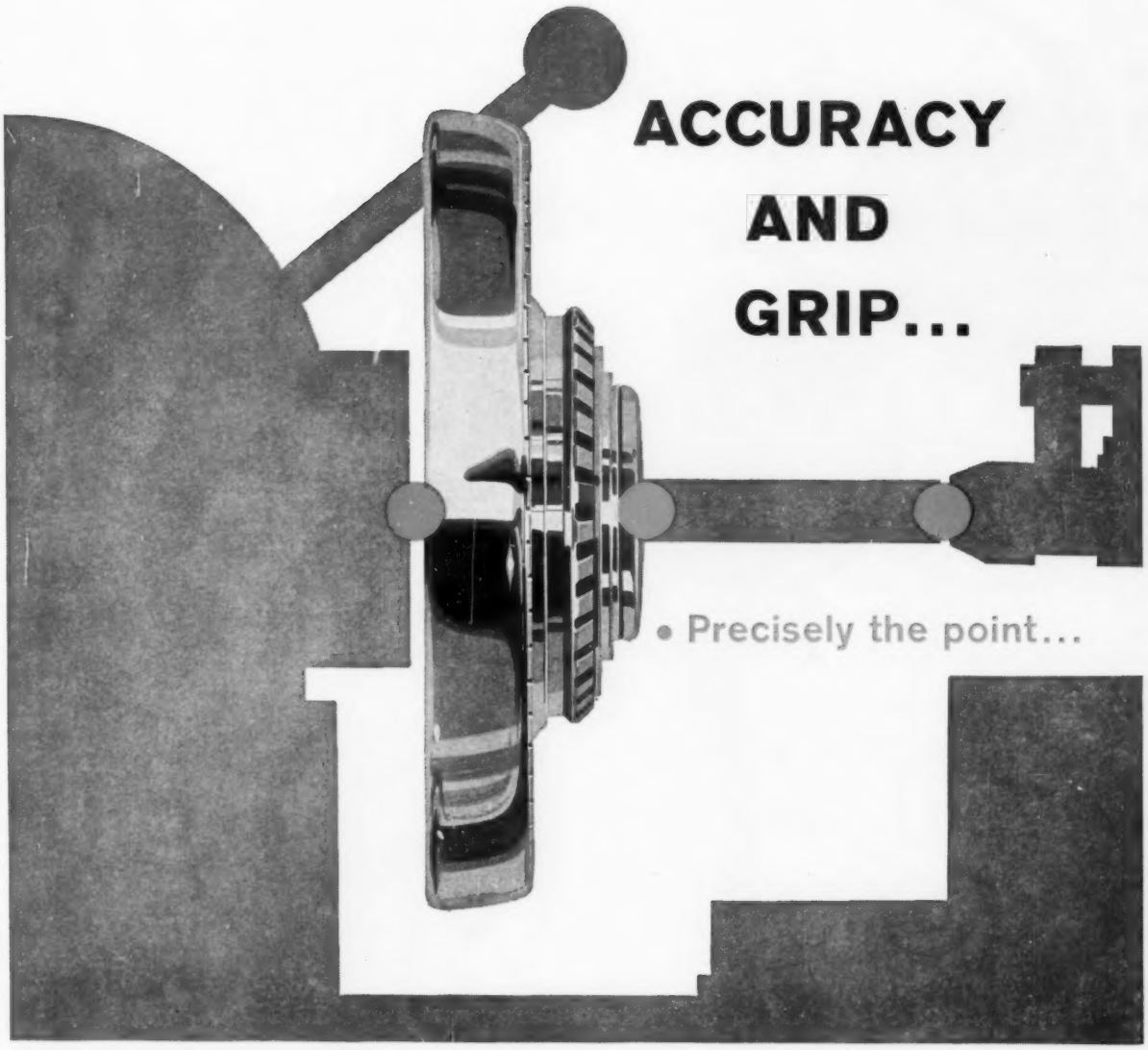
Export Sales Borg-Warner International • 36 So. Wabash, Chicago, Ill.

ROCKFORD B-W CLUTCH DIVISION OF BORG-WARNER



When you buy new tools or rebuild old ones

START UP FRONT

- Precisely the point where the tool does its work.
- Precisely the point where profits are made and lost.
- Precisely the point where the accuracy and grip of Jacobs Chucks reduce tool breakage, downtime and rejects.

This is precisely the point, start up front with Jacobs.

The Jacobs Model 91 is the world's finest lathe collet chuck. Developed expressly for the world's finest engine and tool room lathes. Modernize your lathes with Model 91.

- It has the **range**—each collet has full 1/16" range and set of 11 chucks any bar between 1/16" and 1 3/16".
- It has the **grip**—two to four times as much as split steel collet equipment.
- It has the **accuracy**—the world's most accurate collet chuck. Manufactured to maximum runout limits of .0007"—T. I. R. at the nose.

INDUSTRIAL TEAMWORK

Your industrial supply distributor knows your business. He is always ready to fill your needs quickly and economically. When you need chucks you can depend on this industrial team—Jacobs and your Jacobs industrial supply distributor.

Jacobs CHUCKS

THE JACOBS MANUFACTURING COMPANY,
WEST HARTFORD, CONNECTICUT

This machine is a technical breakthrough.

This is the essence of precision.

In my opinion, Centalign® bore grinding and race grinding equipment is the finest and most modern single purpose equipment available anywhere in the world today.

No comparable machine available from other sources.

These actual quotations are typical of what people throughout the metalworking industry are saying about Bryant CENTALIGN Internal Grinders. Your nearest Bryant or Ex-Cell-O Sales Representative will be pleased to tell you why.

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Chucking Grinder Co.

58 CLINTON STREET, SPRINGFIELD, VERMONT, U. S. A.

Internal Grinders • Special Machinery

for Strength
. . . Economy
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Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Air-4 Blanks and Draws Bread Slots in GE Toaster Shell

This blanking and drawing die, made from Bethlehem Air-4 tool steel, forms bread slots in .030-in. steel sheet for a General Electric automatic toaster. Hardened to Rockwell C 59, the die sections were made by Yarema Bros. Tool & Die Co., Allentown, Pa. They were pleased with Air-4 for two reasons—minimum distortion during heat-treatment, and easy machinability.

Hardens in Air at 1550 F

One of the big advantages of Air-4, Bethlehem's new free-machining medium-alloy tool steel, is its ability to harden in air at low temperature — about 1550 F. Air-4 has exceptional free-machining characteristics because just the right amount of lead has been added. It has high wear-resistance, excellent toughness, and deep-hardening properties — everything you need for economical tool service.

Our booklet on air-hardening steels includes full data on Air-4. For your copy, write to Publications Department, Bethlehem Steel Company, Bethlehem, Pa. Ask for Booklet 548.

Use Reader Service Card, CIRCLE 37

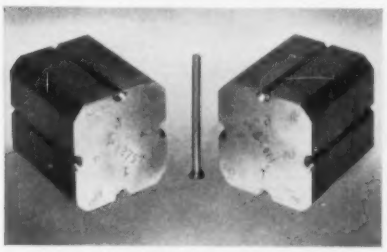
BETHLEHEM TOOL STEEL ENGINEER SAYS:

Lehigh H Is the Work-Horse Of the Cold-Extrusion Industry

Bethlehem's Lehigh H, a high-carbon, high-chromium (AISI type D-2) tool steel, is the most widely used tool steel in the cold-extrusion industry. And for good reasons. Lehigh H has an unusually good combination of properties: high compressive strength, deep hardenability, and high resistance to wear.

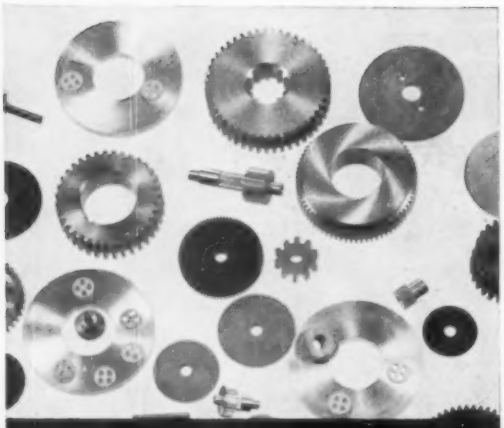
Lehigh H is used for a wide variety of cold-extrusion tools, such as punches and mandrels which are subject to compressive loads or abrasion. Whenever it is used for containers, bushings, or similar parts which are subjected mainly to tensile loads, it is supported by an external shrink ring.

Cold-extrusion tools of Lehigh H are usually made to a hardness of Rockwell C 58-60. Occasionally they are tempered back to C 55 to avoid breakage. Using a hardness above C 60 is not recommended, because such a hardness is obtained only at a sacrifice of proper tempering.



COLD-HEADING DIE STEEL SPEEDS HEADING OF SCREW BLANKS

These gripper dies are used by Southern Screw Company in forming blanks from steel wire. The dies, made of Bethlehem Cold-Heading Quality tool steel, produce about 150,000 blanks before redressing is required. Bethlehem Cold-Heading steel resists shock because it is carefully controlled for hardenability. It also has a carbon range selected to give good wear-resistance and high toughness.

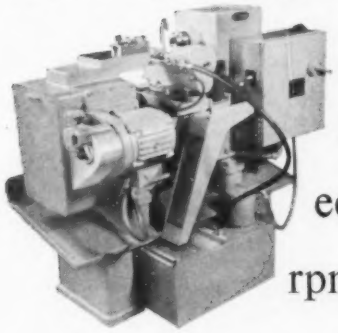


■Here is an opportunity to add powerful sales appeal to your product without increasing costs. As a result of recent Barber-Colman innovations in hobbing, it is economically feasible to put instru-

NEW

ment gear quality into any product. / The new method is production hobbing of fine-pitch spur gears of AGMA Precision Class 3 quality... quality which cannot be produced economically by any other method. It's the new No. 2½-4, a machine which Barber-Colman guarantees will index accurately within 20 seconds of arc. This means that in a 2" diameter gear, nonadjacent tooth-spacing error caused by machine indexing can be held within

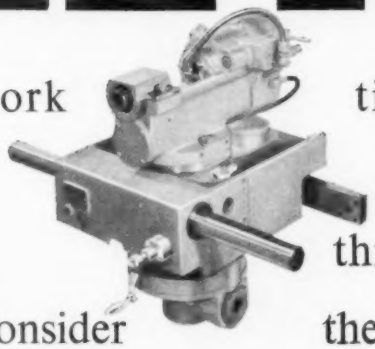
.0001". / This extraordinary precision has been combined with economy through machine simplicity. The position of the work



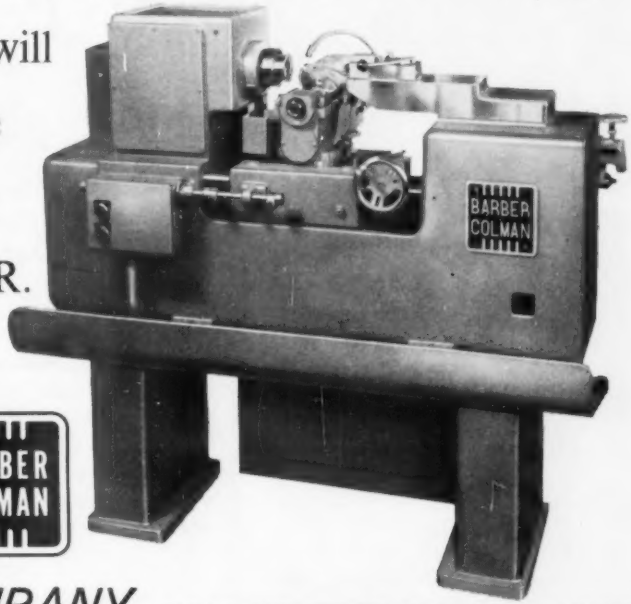
spindle of the No. 2½-4 is fixed, increasing rigidity. Hob carriage is completely antifriction-equipped. Hob speed is infinitely variable to 1200 rpm. A stiff, direct-feed drive eliminates error in

METHOD

hob-to-work



timing. These and other unique machine features are triggering important break-throughs in gear-cutting cost and quality. Consider the total impact of product improvement through precision gearing in your industry—of "cost-free," plus values your customers will recognize and buy. / See the No. 2½-4 hobbing your gear blanks in our TEST CENTER. Your Barber-Colman representative will make all the arrangements.



BARBER COLMAN

BARBER-COLMAN COMPANY 612 LOOMIS STREET, ROCKFORD, ILLINOIS

Atrax

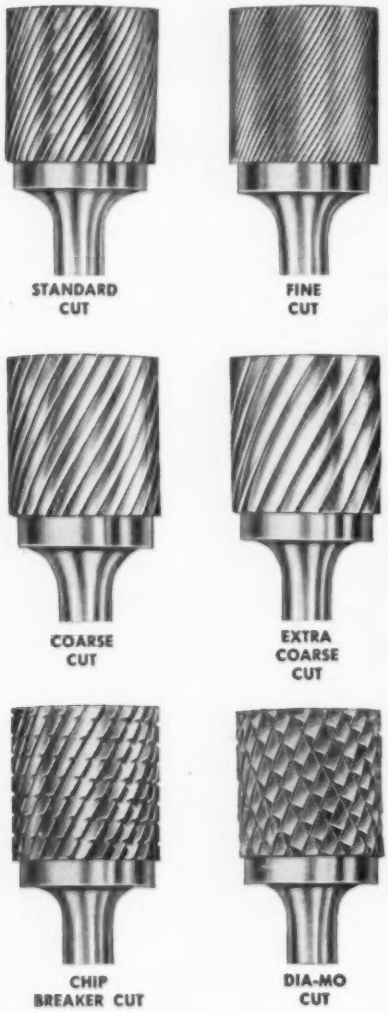
Precision Ground

SOLID CARBIDE TOOLS AND BURS

HOW TO BECOME AN EXPERT IN SOLID CARBIDE BUR SELECTION

Solid carbide burs are universal roughing and finishing tools. Atrax, manufacturing the most complete line, can furnish a size and shape to accomplish practically any metal removal or finishing operation.

SIX BASIC CUTS



Applying the Chip Breaker or Dia-Mo cut to the other types offers 11 different available cutting combinations for each size and shape of bur.

14 DIFFERENT SHAPES

To make burs one of the most versatile of metalworking tools, 15 standard shapes—181 different sizes, each in the 6 cuts, make available a total of 1086 different burs for a large variety of metalworking requirements.

PRODUCTION VERSATILITY

Atrax Burs, because of their controlled tool geometry and precision uniformity, are recommended for use on virtually all materials.

BUR SELECTION AND SPEEDS

Bur selection depends on the operation and material to be cut. Bur speed also depends on these factors and on diameter of bur used.

STANDARD BUR SETS

Atrax Solid Carbide Standard Bur Sets are also available through your dependable Atrax Distributor.

Complete engineering information on bur selection and use can be found on page 12 of the 148 page Atrax Catalog.

Be sure to send for your free copy today.

There is an Atrax Precision Ground Solid Carbide Tool engineered to every material and job application.

SEND FOR "STANDARD" REFERENCE ON SOLID CARBIDE TOOLS

THE ATRAX COMPANY

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Quality... the best economy of all

Another product of Sunoco research . . . a fire-resistant hydraulic fluid

The flame test, above, dramatizes the effectiveness of Sun's new fire-resistant hydraulic fluid. The wick in the conventional fluid burns readily; the wick in Sun's new fluid just can't be lighted.

SUNSAFE, a water-in-oil emulsion, eliminates fire hazards . . . provides increased safety to personnel and equipment. At the same time, operators get the essential performance characteristics of a top-grade hydraulic oil—low rates of wear, long service life, and protection against rust and corrosion.

This combination of *quality* in engineering know-how, and *quality* in product, proves once again that *quality* in any sense is the best economy of all.

For 73 years Sunoco has meant quality right down the line. Today, this quality is found in more than 400 Sunoco industrial products. SUN OIL COMPANY, Phila. 3, Pa., Dept. I-14. In Canada: Sun Oil Company Limited, Toronto and Montreal.

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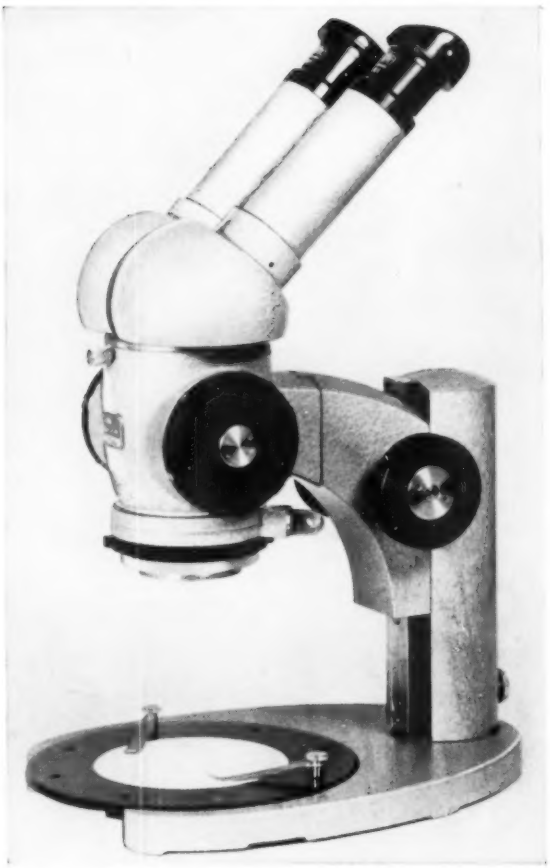
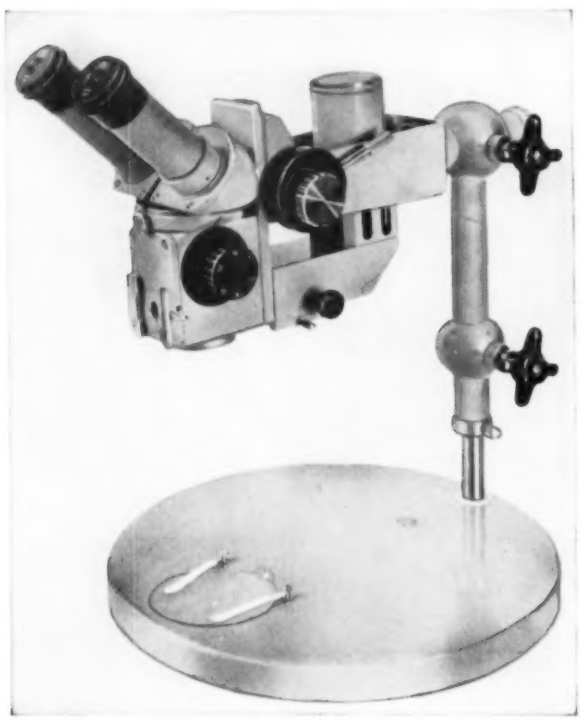
WEST GERMANY

NEW Stereo Microscope II

Produces an image of outstanding plasticity—erect, unreversed, and uniformly sharp over the entire field of view . . . Easy on the eyes, even under prolonged observation . . . Novel, rapid change of magnification from 2.5x to 100x, with wide-angle oculars . . . Large working distance—3⅛″—with diameter of object field up to 50mm. Beyond 100x magnification, a 2x supplementary objective is available, having a working distance of 1⅛″.





EPI-Technoscope

A modern stereoscopic binocular microscope eminently suited for industrial inspections and examinations. Intense illumination parallel with line of vision. Erect, plastic image even in deep cavities. Free working distance of 8 inches. Magnification changing device provides rapid succession of 6.3x, 10x, 16x, 25x and 40x magnifications.

Write for literature on these advanced instruments

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COMPLETE SERVICE FACILITIES

MIKRON TYPE 21/0

HYDRAULIC GEAR HOBBING MACHINE

precision PLUS *production*

"THREE MACHINES —one basic unit"

1. HAND LOADING
2. SEMI-AUTOMATIC MAGAZINE LOADING
3. FULLY AUTOMATIC HOPPER LOADING

FEATURES:

- Infinitely variable hydraulic feeds
- Automatic box type hob cycle...no hob approach
- High spindle speeds...4800 rpm maximum
- High production rates
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- Centralized lubrication
- Automatic part deburring
- Low cost tooling
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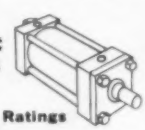
THIS...IS WHAT YOU BUY!

POWER — clean, dry, drip-free power at the business end of a Hannifin piston rod is the result of Hannifin extra quality, and at no extra cost. Bores are honed to 15 RMS or finer... piston rods are case hardened, plated and polished to 10 RMS or better. Cartridge gland, removable without dismantling cylinder, has exclusive Hannifin-developed "Lipseal®-Wiperseal" combination for a truly drip-free rod.

Modern straight thread leak-proof ports for easily positioned fittings are available at no extra cost on hydraulic cylinders.

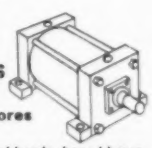
HYDRAULIC CYLINDERS



Two Pressure Ratings

2000 psi (3000 psi non shock), the famous heavy duty Hannifin Series "H" in 1½" to 12" bore.
1000 psi, Series "L", 1" to 8" bore. Hannifin quality in a lighter cylinder. Full compliance JIC Hydraulic Specs.

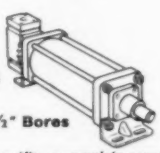
AIR CYLINDERS



1½" to 14" Bores

Series "A"—steel heads, honed brass body for corrosion resistance. Hardened and hard chrome plated piston rod. For all heavy duty air service. Easily modified for water service. Full compliance JIC Pneumatic Specs.

AIR MOTORS



1¾" to 4½" Bores

New from Hannifin, a complete power package combining cylinder and solenoid valve. Only one air line connection. Four mounting styles. Interchangeable mounting dimensions for most applications.

HANNIFIN COMPANY
A DIVISION
519 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS
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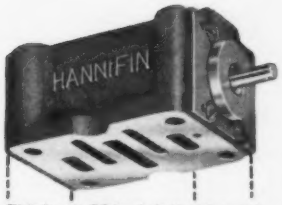
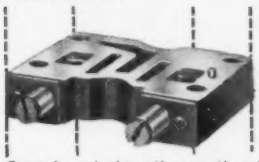


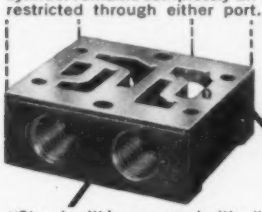
This basic CC body is the "heart" of every CC valve. Its one moving part is the "spool poppet", a Hannifin exclusive that seals bubble tight at either end of its short stroke. Note the ample air passages—all ¼" IPS or larger. This is single-actuator, spring return version.

This is the same body with double-end "spool poppet"—used when two actuators are required.

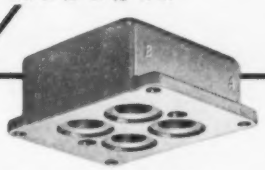


Speed control section, optional—designed to restrict exhaust flow, only, through either or both cylinder ports. Flow to the cylinder remains completely unrestricted through either port.

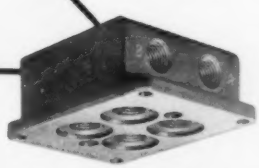
For foot-operated valves, the actuator is also the base, and this rear-ported adapter is used. Available tapped either ¼" or ⅜" IPS.



"Standard" base—used with all but foot-operated models. Every CC base is available tapped either ¼" or ⅜" IPS.



Optional base for "O" ring gasket mounting. Supplied complete with 4 O-rings.



"Universal" base, tapped from beneath and from both sides. Four pipe plugs supplied. Can also be used with O-rings.

THESE QUICK-RESPONSE 4-WAY VALVES MOVE AIR DOWN THE LINE—FAST!

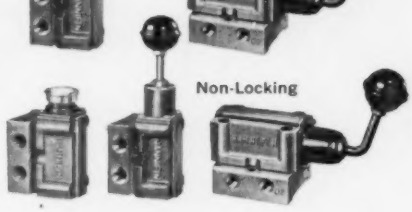
Hannifin CC valve design is the reason. Short, positive strokes of the "spool poppet" open up instant and ample passages for air.

Actuation? Any way you want it!

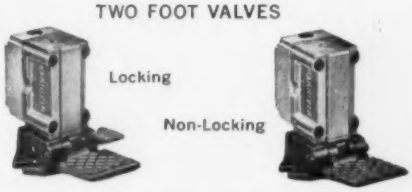
One basic body with a wide selection of operating heads and bases—all with or without our new speed control section—give you over 3,000 choices. We can help you make the right choice . . . through our field engineering service. Call your nearest Parker-Hannifin office or write us direct for full information.

SINGLE ACTUATORS
(Spring Return)

FIVE HAND VALVES



TWO FOOT VALVES



TYPICAL COMBINATIONS
(Hundreds Available)

FOOT-OPERATED, LOCKING; PRESSURE OVER-RIDE —used on foundry machinery

CAM-OPERATED; PRESSURE-RETURN —used on automatic wash tanks

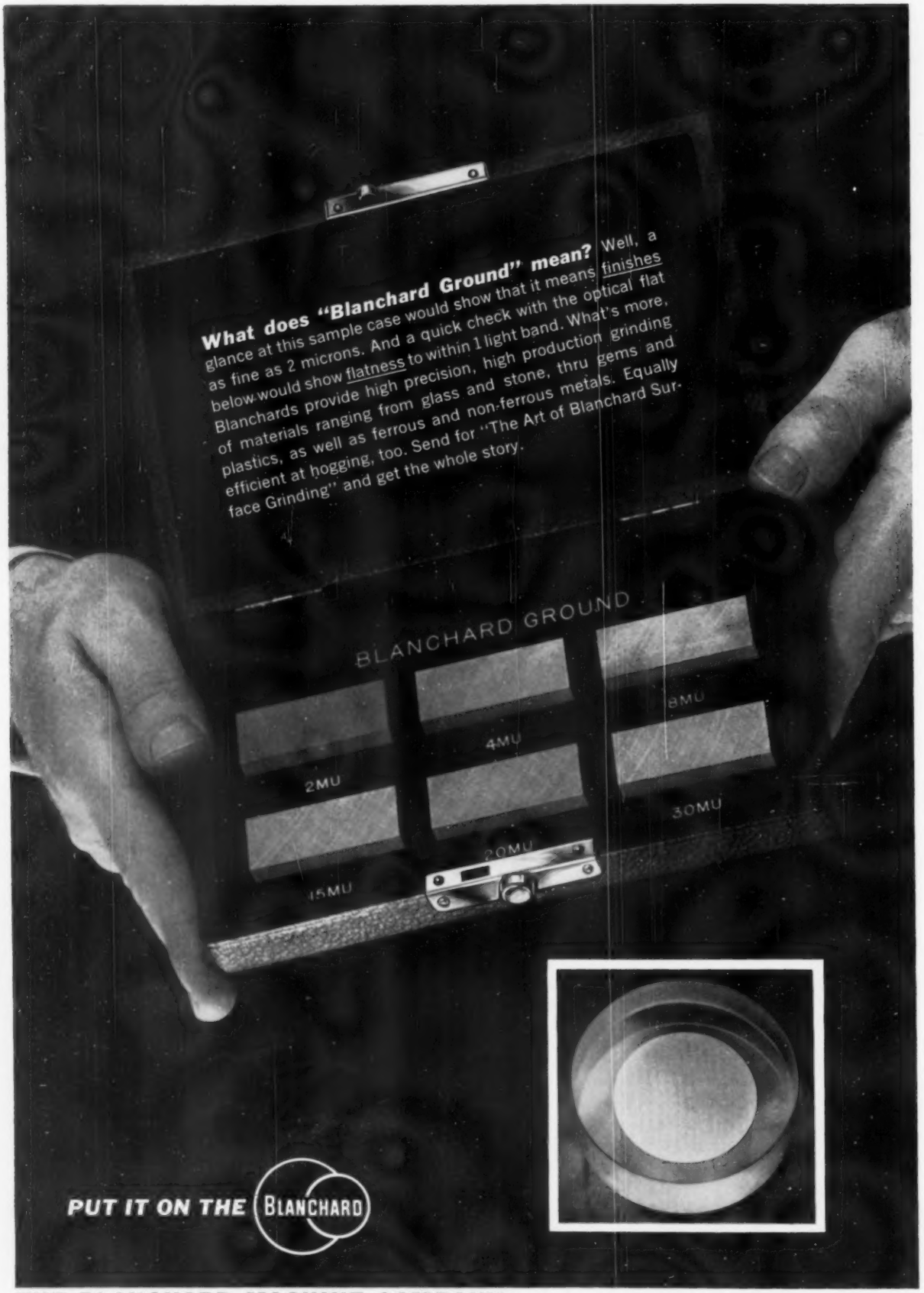
DOUBLE SOLENOID —used everywhere

PRESSURE-OPERATED; PRESSURE-RETURN —used everywhere

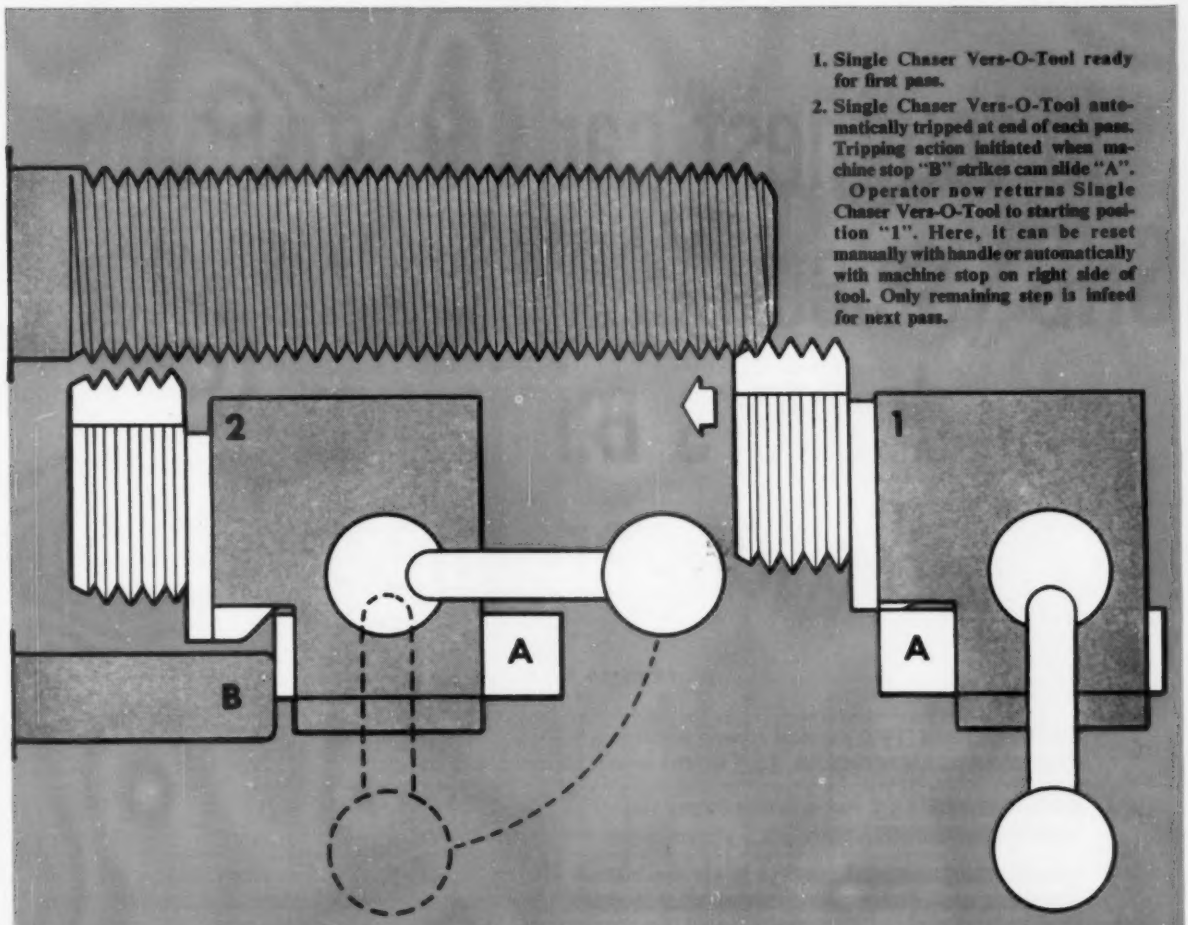
PARKER HANNIFIN CORPORATION

HANNIFIN COMPANY
A DIVISION
519 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3138 PH.



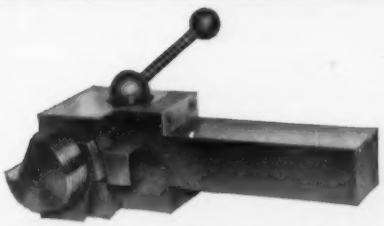
THE BLANCHARD MACHINE COMPANY 64 State Street, Cambridge 39, Massachusetts



Only NAMCO's Single Chaser Vers-O-Tool

Trips Automatically... Boosts Short Run Threading Efficiency

Unlike other single point threading tools, NAMCO's Single Chaser Vers-O-Tool backs off automatically at the end of the cutting stroke. For short runs, this means more threading in less time. And, because it just isn't possible to attempt the return stroke while the tool is still at cutting depth, scrappage is eliminated. The tool's multiple cutting edges mean greater threading accuracy and longer tool life while NAMCO's exclusive resharpening method permits quick tool change and precise reset. In short, *nothing* beats NAMCO's Single Chaser Vers-O-Tool for short run threading efficiency. Get complete details on this and all the rest of NAMCO's complete line of Vers-O-Tools. Write today for our 44 page Bulletin DT-60.

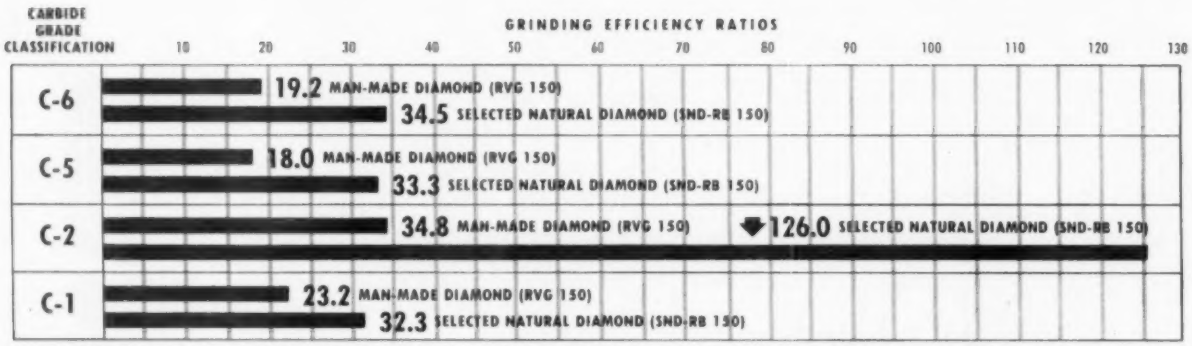


National Acme

THE NATIONAL ACME COMPANY
193 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

In toughest carbide grinding, SND (Selected Natural Diamond) delivers minimum of 40% longer wheel life!



TEST CONDITIONS—Wet Grinding • WHEELS: DIAl Peripheral (5" x 3/16" x 1 1/4") • SPINDLE SPEED: 4200 RPM. (5500 S.F.M.) • DOWNFEED: .002" • CROSSFEED: .042"

SND (Selected Natural Diamond) outgrinds man-made diamond *on every carbide grade you use*—for unequalled savings in wheel and production costs! The unique performance capabilities of SND—the most advanced development of diamond technology—are demonstrated conclusively by extensive evaluation tests in precision grinding operations.

This chart shows how emphatically SND outscores man-made diamond, even in toughest carbide grinding procedures—grinding with up to *262% greater efficiency on C-2 carbide . . . with 40% greater efficiency on extremely hard C-1 carbide*. These performance results are the reasons why SND can insure longer wheel life, greater wheel output for maximum surface grinding economy.

Discuss SND with your diamond wheel representative. He has the useful experience and information to help you select SND in the diamond wheel best suited for your production requirements.

For information on new developments in precision grinding with industrial diamonds—including test results proving SND superiority—write for Engelhard Hanovia's technical bulletins.

★ENGELHARD HANOVIA, INC.★
INDUSTRIAL DIAMOND DIVISION
113 ASTOR STREET • NEWARK 2, NEW JERSEY

WALKER-TURNER 17" DRILL PRESSES

EVERYTHING NEW

but the price!

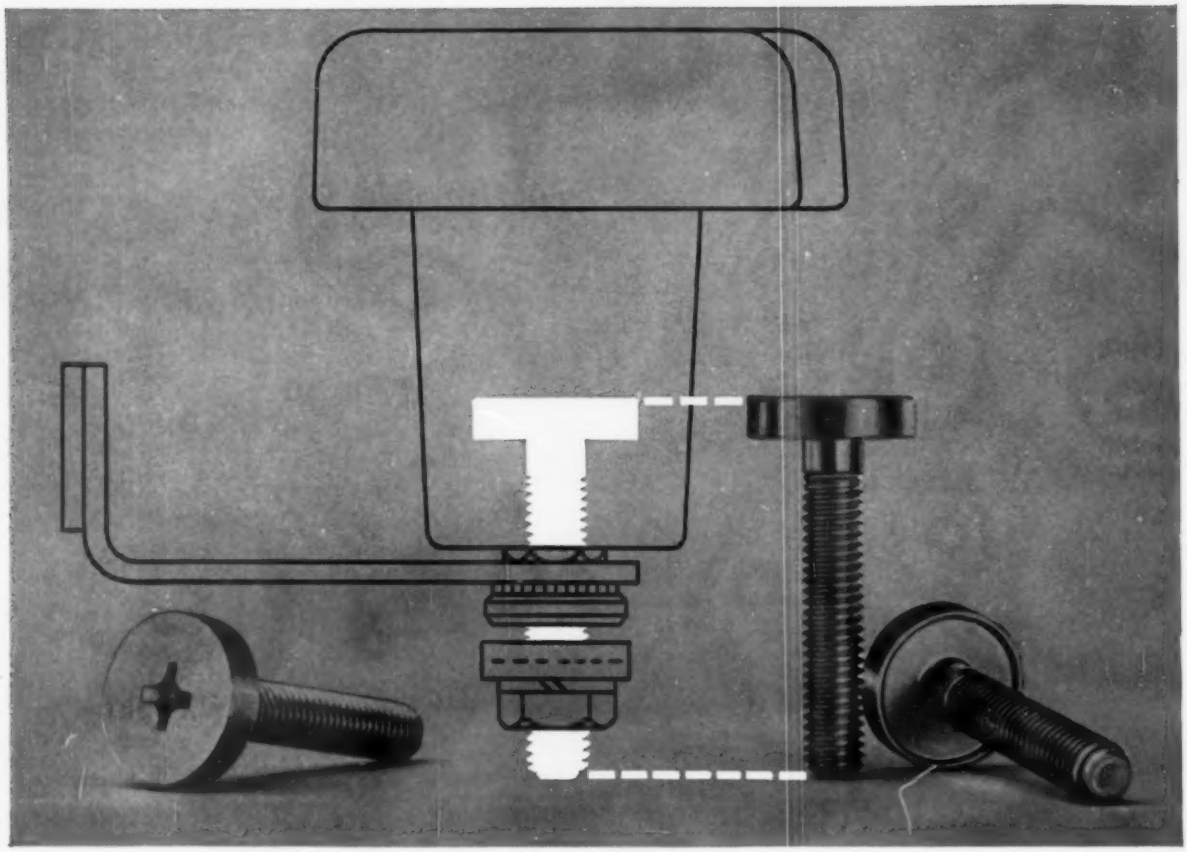
Because the entire line of W-T "Light-Heavyweight" 17" Drill Presses has been completely redesigned, it now gives you new flexibility, new accuracy and new convenience. You'll like the increased operating economy you get, but even more, you'll like the price tag. All 44 hand feed models of the "New 17" are being introduced at no increase in cost! And for semi or fully automated drilling jobs, you can add new Rockwell Power Feed. This low cost accessory is available on every model.

Only *you* can rate the value to your job of pacesetting features such as New Concept Depth Stop, New "Swing Away" Guard and New "Pivoting" Motor Mount. To see this machine in action visit your Walker-Turner Distributor (listed under TOOLS or MACHINE TOOLS in the Yellow Pages). Learn for yourself why more people in metalworking call Walker-Turner the *value* line.

FREE BROCHURE pictures and describes the complete line of W-T 17" Drill Presses. Write: Rockwell Manufacturing Company, Walker-Turner Division, Dept. WF-25, 400 N. Lexington Ave., Pittsburgh 8, Pa.

WALKER-TURNER
"LIGHT-HEAVYWEIGHT" MACHINE TOOLS
another fine product by
ROCKWELL

Use Reader Service Card, CIRCLE 49



CUNISIL, new Anaconda copper-nickel-silicon alloy, gives you high strength for tough electrical jobs

THE PROBLEM: The studs for Line Materials Secondary Class Lightning Arresters (illustration above and below left) call for an unusual combination of properties. They must have high physical strength for structural reasons and to handle the stresses of high surge currents. Yet they must also have relatively high electrical conductivity. And for economical fabrication, the alloy must have good cold-forming characteristics and be readily machinable.

LINE MATERIALS Type S-3 Secondary Class Arrester with stud of Cunisil, copper-nickel-silicon alloy. Cunisil is also used for lower studs of Line Materials Protective Gaps.

THE SOLUTION: Continental Screw Company, which makes the studs for Line Material Industries, found the answer in Cunisil-837, Anaconda's versatile new high-strength, heat-treatable alloy with these valuable properties in the precipitation-hardened condition:

Tensile strength—psi min.	90,000
Yield strength—at .50% extension under load, psi min.	70,000
Elongation in 4 x D, min.	8%
Machinability, (Free Cutting Brass=100)	40
Electrical Conductivity, % IACS, as heat treated	30 to 42

In addition, Cunisil-837 has corrosion resistance comparable to copper and Everdur® copper-silicon alloys—and is easy to work cold before heat treatment.

METALLURGICAL COMMENT. Most of the nickel and silicon in heat-treated Cunisil is present as an intermetallic compound, nickel silicide, and it is the precipitation of nickel silicide in the form of particles of submicroscopic size by a relatively low temperature heat treatment that accounts largely for the distinctive properties of the alloy.

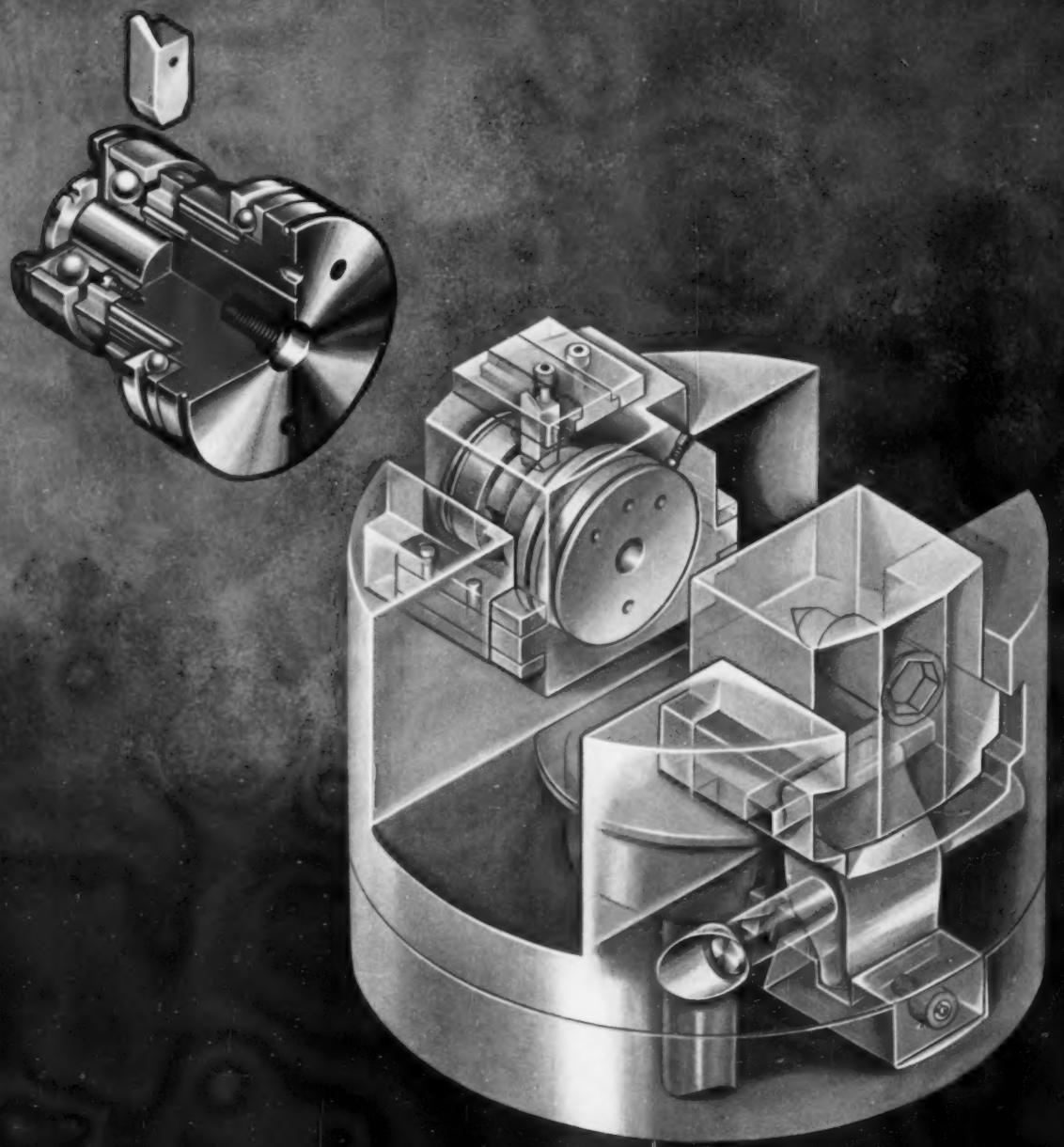
Prior to the hardening heat treatment, the alloy is brought to a proper condition for hardening with a solution anneal at a much higher temperature and then a water quench from this temperature; at this stage the alloy is quite soft and in a condition for drastic cold-working operations. The hardening heat treatment consists of heating at a controlled temperature for a definite length of time to obtain the desired mechanical properties.

For more information—see your Anaconda American Brass representative, or write: Anaconda American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 6149

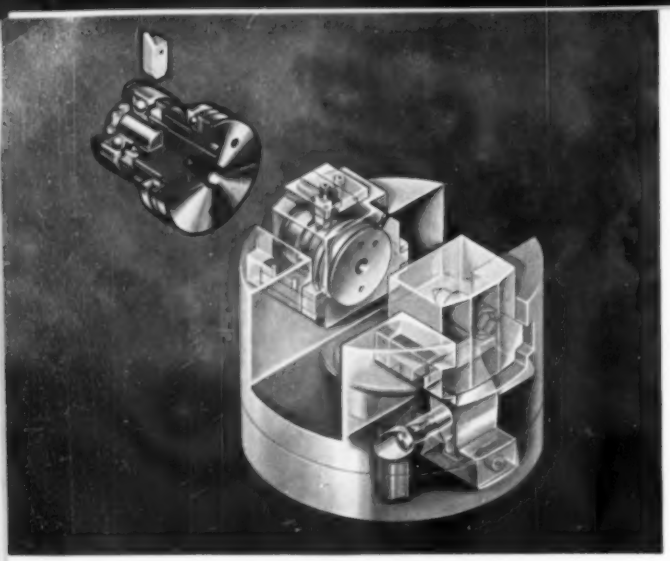
ANACONDA®

COPPER AND COPPER ALLOY MILL PRODUCTS

Anaconda American Brass Company



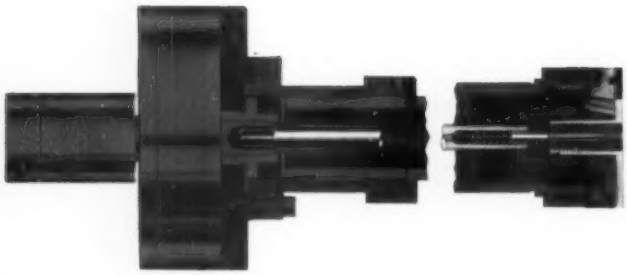
Here is another major chuck development from **SKINNER**



A heavy-duty power chuck with jaws that freely index under full pressure. Indexing is simple, easy, and fast. The operator can index manually without touching the work or releasing the pressure. Jaws are indexed by means of a lock screw and slide plate. Note the size and shape of the indexing pin. It fits firmly and positively into the indexing plate so that extreme accuracy of indexing is assured.

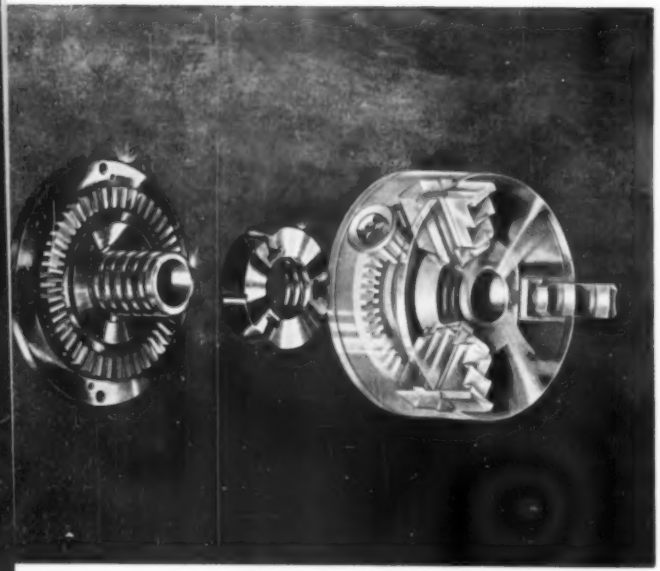
One or both jaws can be furnished with indexing mechanisms. As a result, you can index more positions and smaller index angles. There is no need to buy a new chuck for different indexing positions because index jaws or index components can be interchanged quickly and easily.

This new Skinner chuck is available in all body diameters from 12″ through 36″.



The only power chucking unit for Brown & Sharpe and similar automatic and hand screw machines. The addition of this unit to your screw machine permits power chucking of cold drawn parts, small or odd shapes and castings.

The Skinner unit, recommended by Brown & Sharpe, consists of a 4-inch air chuck with two or three jaws and work ejector, a threaded draw bar, a rotating air cylinder and a cylinder adapter. Hand, foot, or solenoid valves and power chucking accessories are also available. Average installation time—ninety minutes.



The first major chuck development in fifty years! This extra-heavy-duty Wedge-Screw chuck develops tremendous gripping power, high accuracy and repeatability by a unique principle. When the lug-type pinion is turned manually or by a power wrench, it engages the gear plate causing the screw to move the wedge. The force of the wedge on the jaws holds the work with tremendous power.

This Wedge-Screw chuck has such useful features as:

Accuracy—within .001 total indicator reading

Repeatability—within .0005 total indicator reading

Complete Range—no size limitation

Many other features including over-tightening and operator protection, sealed operating mechanism, automatic lubrication, etc.

For more information about these major chuck developments, contact your Skinner representative or write directly to us.

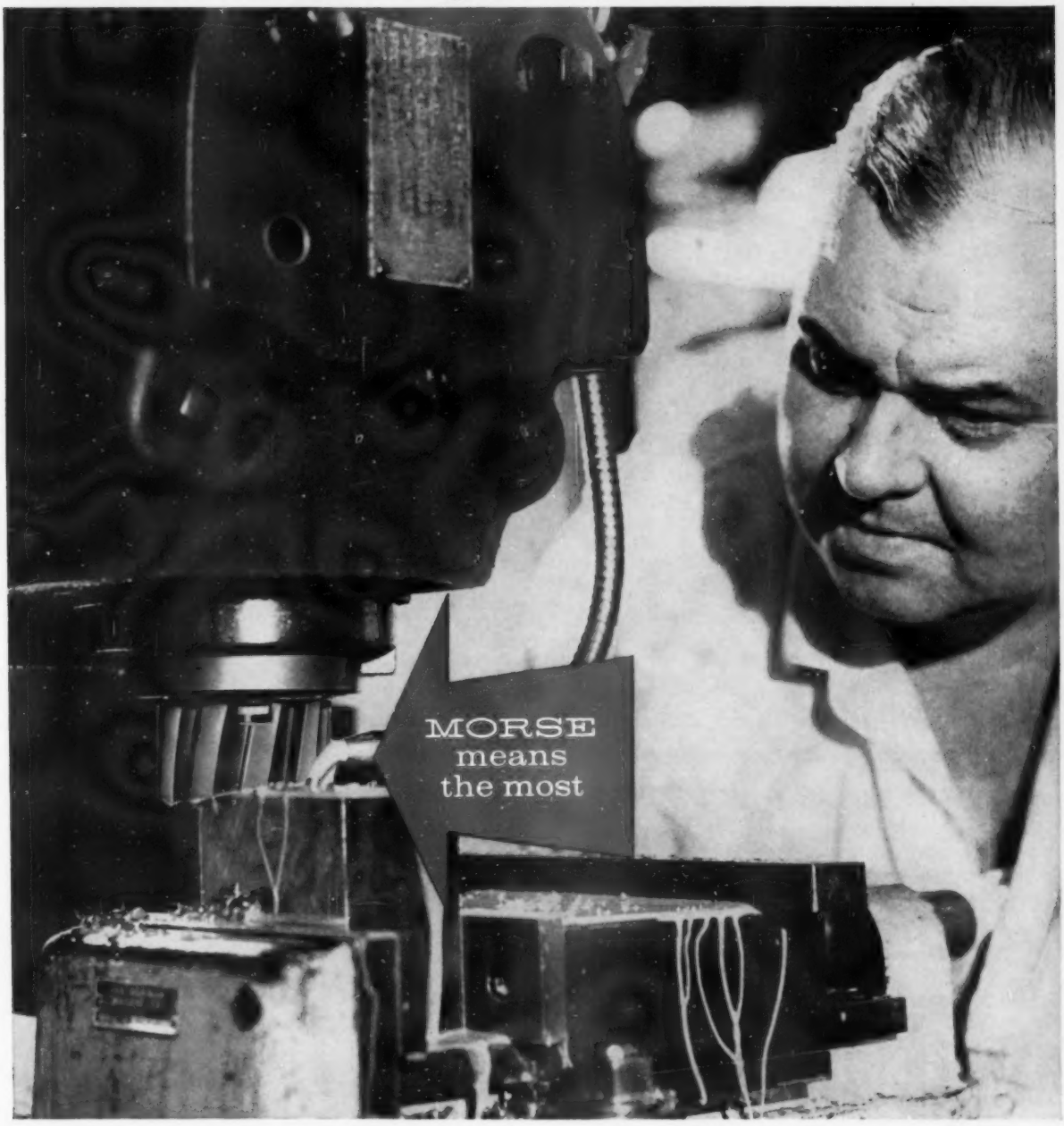
THE CREST OF QUALITY

SKINNERCHUCKS

SKINNER-HORTON CHUCK DIVISION
SKINNER PRECISION INDUSTRIES, INC. • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.

with men who know cutting tools... it's MORSE everytime



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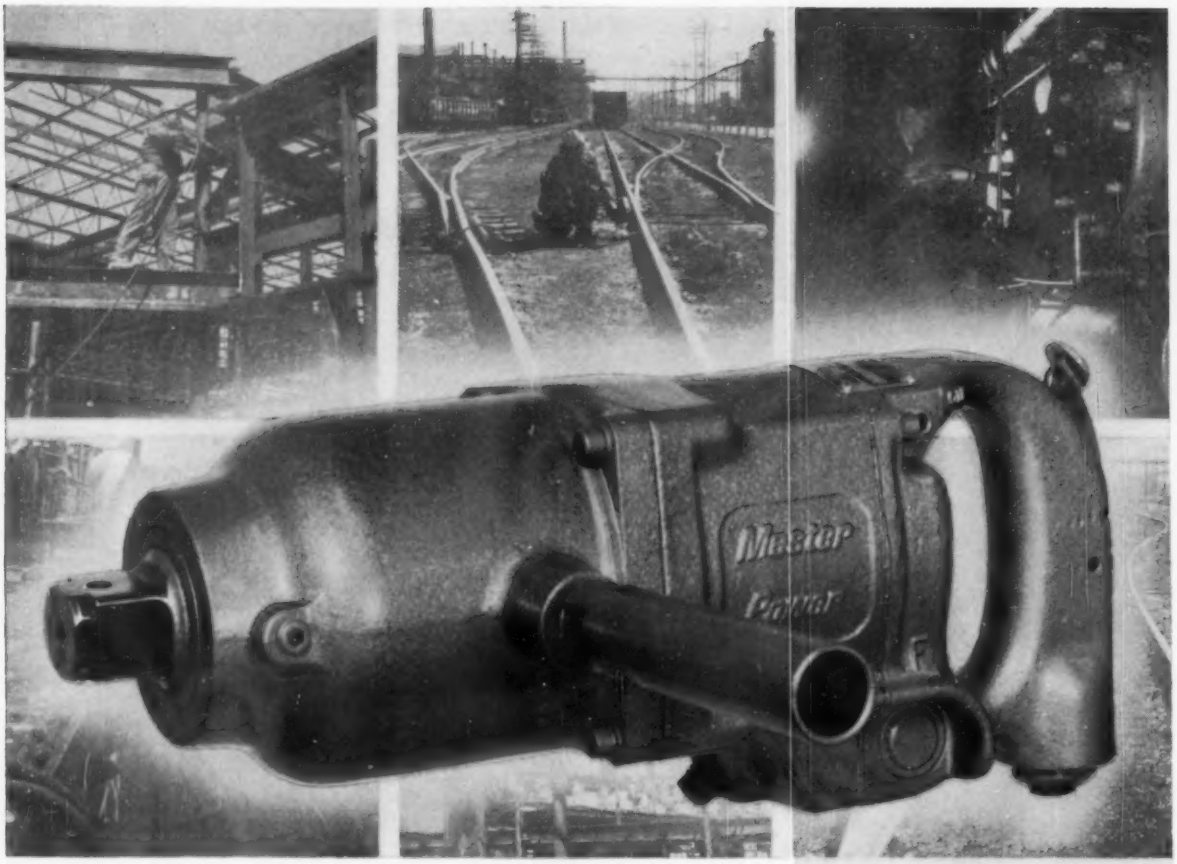

FEATURES OF THE ALL-NEW MASTER POWER 990 IMPACT WRENCH

- For 1¼" high-tensile bolts
- Weighs only 21 pounds
- New "roll-action" engages and disengages impact mechanism
- Popular, protected, push-type reverse valve
- Compact design gives greater maneuverability.
- Hardened, wear-resistant motor end-plates and liner.

NEW LIGHTWEIGHT CHAMP FOR HEAVY-DUTY WORK

This new Master Power 990 Impact Wrench went to work more than a year ago in shipyards, steel mills, rail yards, on off-the-road equipment, on steel erection and truck assembly. The toughest kind of work in the roughest environments. Our documented performance data is your proof that the new 990 delivers ultimate power, positive engagement, maximum life.

A combination of "roll action" and precision-engineered, cam-timed impact mechanism gives you a tool with no springs, no snap rings, no lost motion. The tried and proved ball-and-race principle of smooth, almost frictionless rolling action engages and disengages impacting blows with precise timing. The powerful air motor and clutch hammer are independently suspended on heavy-duty bearings. You get positive, full engagement regardless of power input. Result: A compact, light weight (21 lbs.) tool doing up to 1¼" high tensile bolting with less vibration, less torque to operator. Its simplified design permits assembly and disassembly with ordinary tools. Try this new tool *now!*

Ask your nearest Master Power distributor for a demonstration or write us for complete performance information.

Leading Distributors Everywhere

MP Master Power

Master Power Corporation • Solon, Ohio

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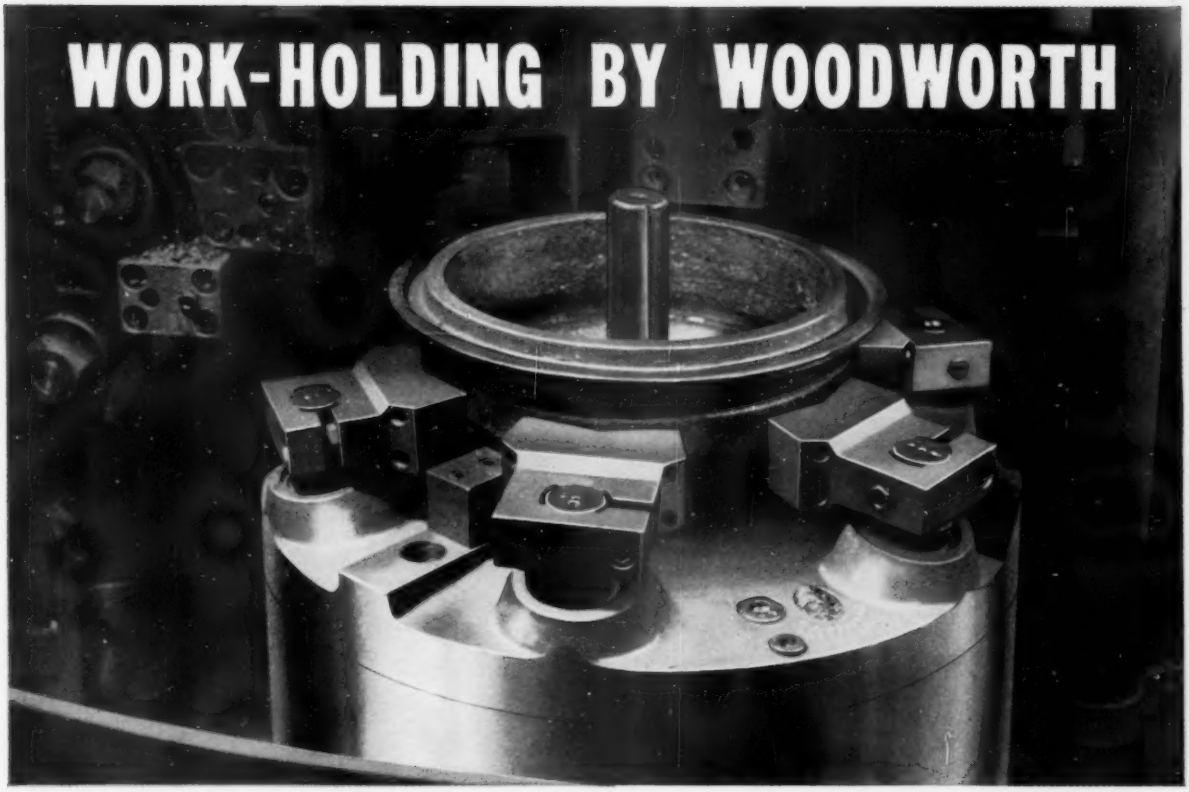
WORK-HOLDING BY WOODWORTH



WOODWORTH'S REVOLUTIONARY "BALL-LOK" ELIMINATES DISTORTION OF THIN WALL PARTS

Kelsey-Hayes set-up man Arthur Priebe (left) and foreman, Charles Usannaz compare brake drums before and after machining.

● In the Hub and Drum Department of **KELSEY-HAYES COMPANY** in Detroit, WOODWORTH "BALL-LOK" POWER CHUCKS were installed (above) on a Bullard Contin-U-Matic for facing, chamfering and rough boring cast iron brake drums.

The completely new and unique "equalization" feature of the "BALL-LOK" permits 6 jaws to "form" to the part without distorting it, yet firmly holds the drum with clamping pressures equally distributed to 12 contact points.

Stock removal per side is .0625 on the I.D. and 250 pounds of hydraulic pressure is used chucking on the 9.950 O.D.

The drum is held in a relatively free state and now machined round within .003 to .005. Distortion was a problem prior to the use of the "BALL-LOK".

The combination of the new Bullard Contin-U-Matic and the WOODWORTH "BALL-LOK" CHUCK has increased production, improved quality and this completely sealed and lubricated chuck eliminates costly maintenance down time.

The distinct advantage of the "BALL-LOK's" pull back action seats the part firmly down against positive stops assuring increased rigidity during machining operations.

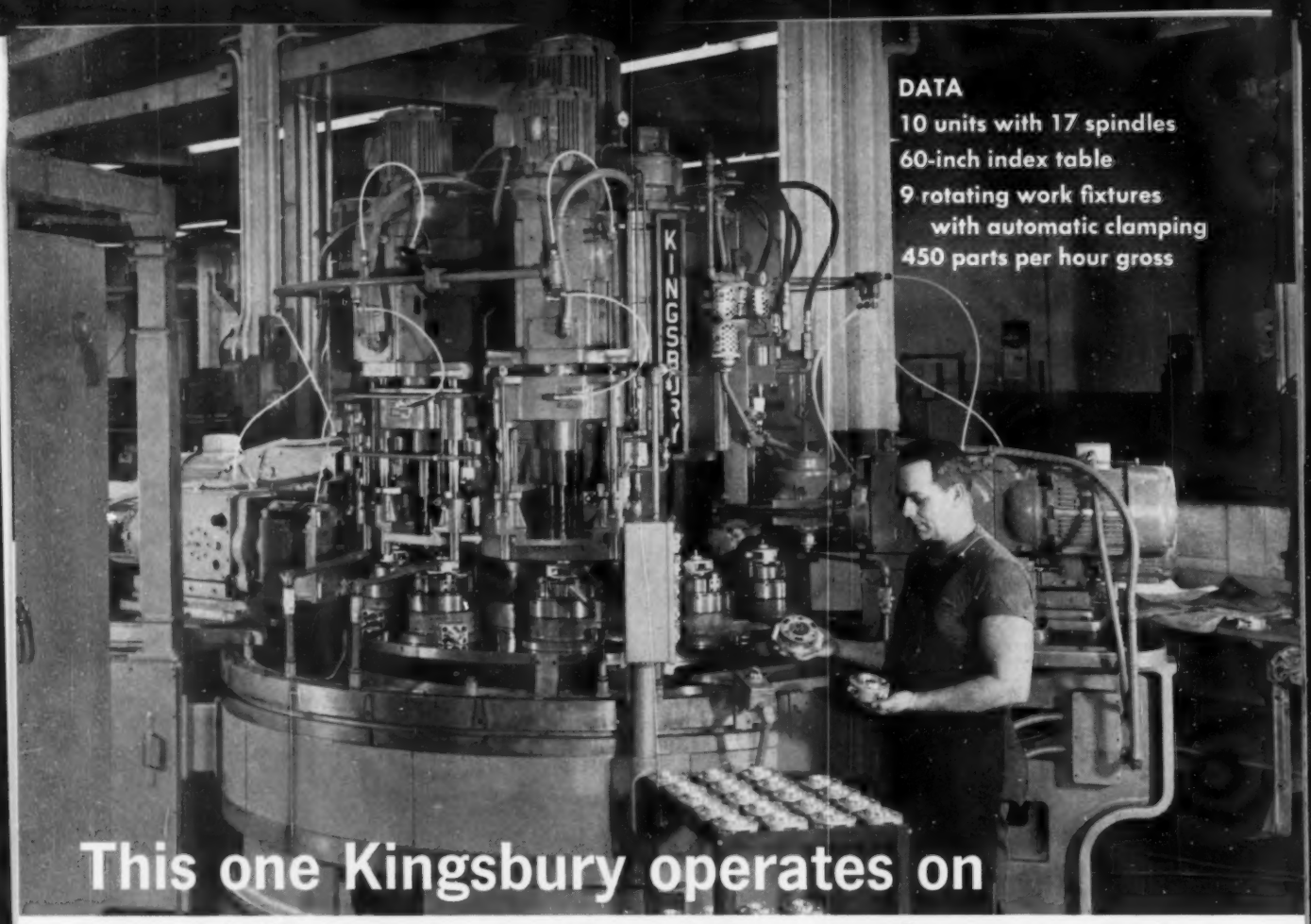
Thin wall parts can now be rough machined while held firmly yet gently (without distortion) on all types of chucking machines and "pull back" against fixed stops will assure parallelism during secondary operations.

When You Buy, Specify

ACCURACY YOU CAN TRUST

WOODWORTH

1300 EAST NINE MILE ROAD • DETROIT 20, MICHIGAN



DATA
10 units with 17 spindles
60-inch index table
9 rotating work fixtures with automatic clamping
450 parts per hour gross

This one Kingsbury operates on two different parts without changeover

Parts may be fed at random
This center column machine works on the two different parts shown with no changeover. The work fixtures hold either part without changing locators. Each fixture rotates 120° with each index of the table so the horizontal units can perform three sets of operations equally spaced.

Two of the vertical units drill two holes, one in each part. One unit drills Hole A in the bottom of the large part when its flange trips a micro switch. The other unit cycles every time, drilling Hole B in the top of the small part, "cutting air" in the large one.

You can make money with a Kingsbury. Here's how:

—One Kingsbury replaces several general purpose machines, saving space and labor.

—You cut work-in-process inventory by eliminating several banks of parts.

—You cut maintenance costs. Because of good basic design and rugged, accurate construction Kingsbury machines have run year after year, through millions of cycles, without serious trouble.

—Your machine can go right into your production line because our test runs before shipment guarantee uniform parts that gage.

May we make a proposal? Kingsbury Machine Tool Corp., Keene, N. H.

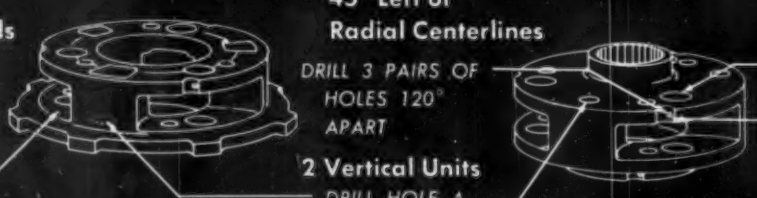
KINGSBURY

3 Horizontal Radial Units with Milling Heads
MILL 3 GEAR POCKETS 120° APART WITH 3.12 DIAM. CUTTER

3 Horizontal Units 45° Left of Radial Centerlines
DRILL 3 PAIRS OF HOLES 120° APART

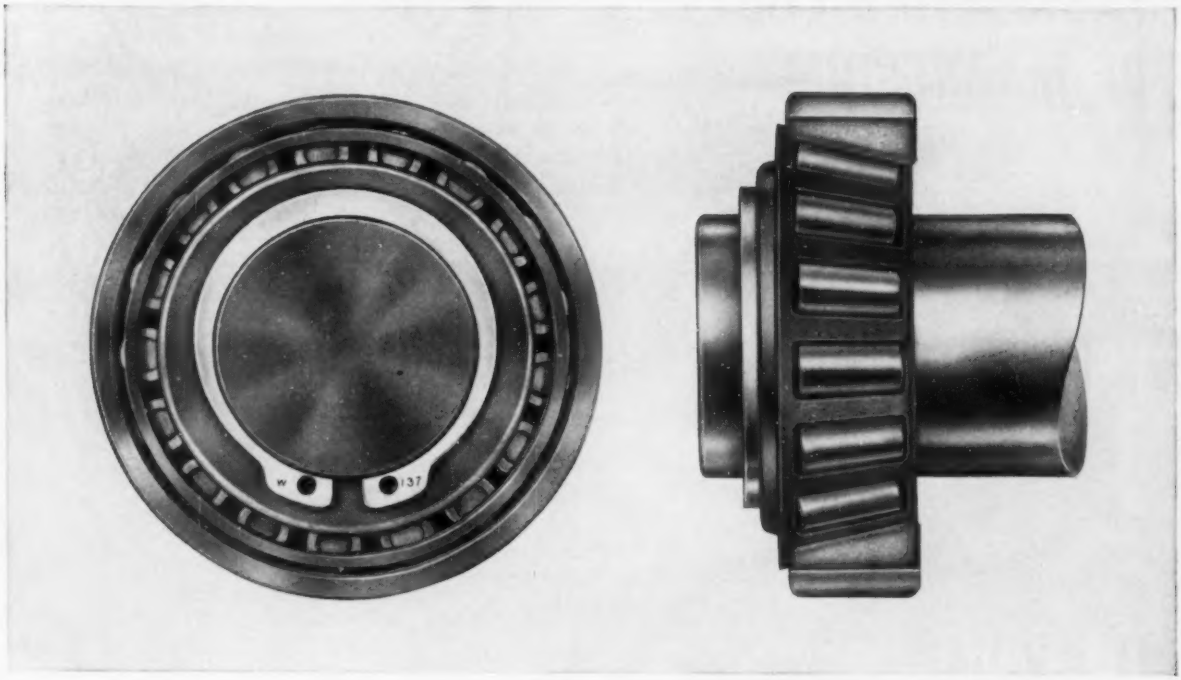
2 Vertical Units
DRILL HOLE A
DRILL HOLE B

2 Vertical Units on Center Column
.563 CORE DRILL - 3 HOLES
END MILL 3 PLACES



ALUMINUM PLANET PINION CARRIERS FOR AUTOMATIC TRANSMISSION

NEW! Waldes TRUARC Series 5160 Heavy-Duty Retaining Ring



for thrust and impact...for retaining bearings ...for a new approach to heavy-duty fastening

Now you can enjoy the benefits of a truly heavy-duty fastener — with all of the advantages and production economies retaining rings provide. The new Truarc Series 5160 is a unique external ring designed to secure components on shafts, axles and similar structural members. It has high thrust load and impact resistance and forms a shoulder sufficiently high to retain parts having large corner radii or chamfers. The Series 5160 is ideal for retaining bearings. You can use it *without spacer washers* to secure ball bearings, tapered roller bearings (shown above) and cylindrical roller bearings — all having large corner breakouts. The ring eliminates the need for machined shoulders, costly heavy-duty nuts and other bulkier and more expensive fastening devices normally required for extreme loading conditions. The Truarc Series 5160 is available in 11 popular sizes for shafts ranging from .473″ to 2.0″ dia. — and other sizes are on the way. You can order the Series 5160 in carbon spring steel or — for corrosion resistance and high temperature limits — in Armco PH 15-7 Mo stainless steel. Sizes up to 1.378″ also are available in beryllium copper. For complete specifications, write for Truarc Data Bulletin No. 459-11. Better yet, contact your local Truarc Representative or Distributor. They're listed in the Classified Telephone Directory under "Retaining Rings" or "Rings, Retaining."

SEE FOR YOURSELF – Send for a free sample of the Truarc Series 5160 Heavy-Duty ring. We'll include a standard external ring of the same size for comparison. You'll see the difference as soon as you open the envelope!

WALDES KOHINOOR, INC.

47-16 Austel Place, Long Island City 1, New York 61-1

DATA
10 units with 17 spindles
60-inch index table
9 rotating work fixtures with automatic clamping
450 parts per hour gross

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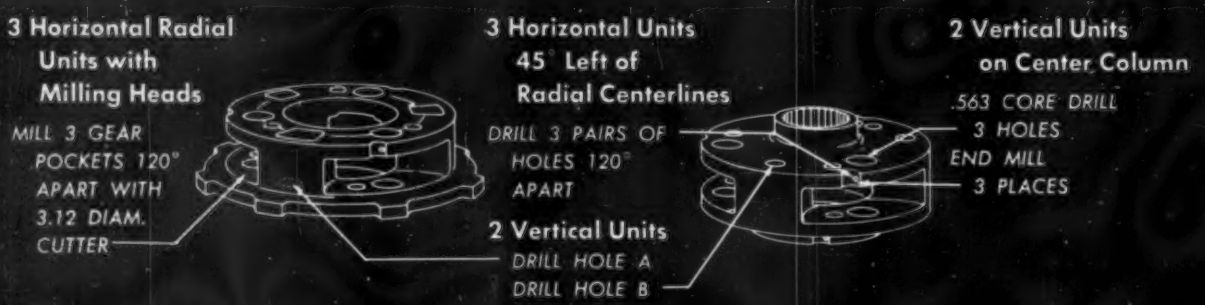
KINGSBURY



ALUMINUM PLANET PINION CARRIERS FOR AUTOMATIC TRANSMISSION

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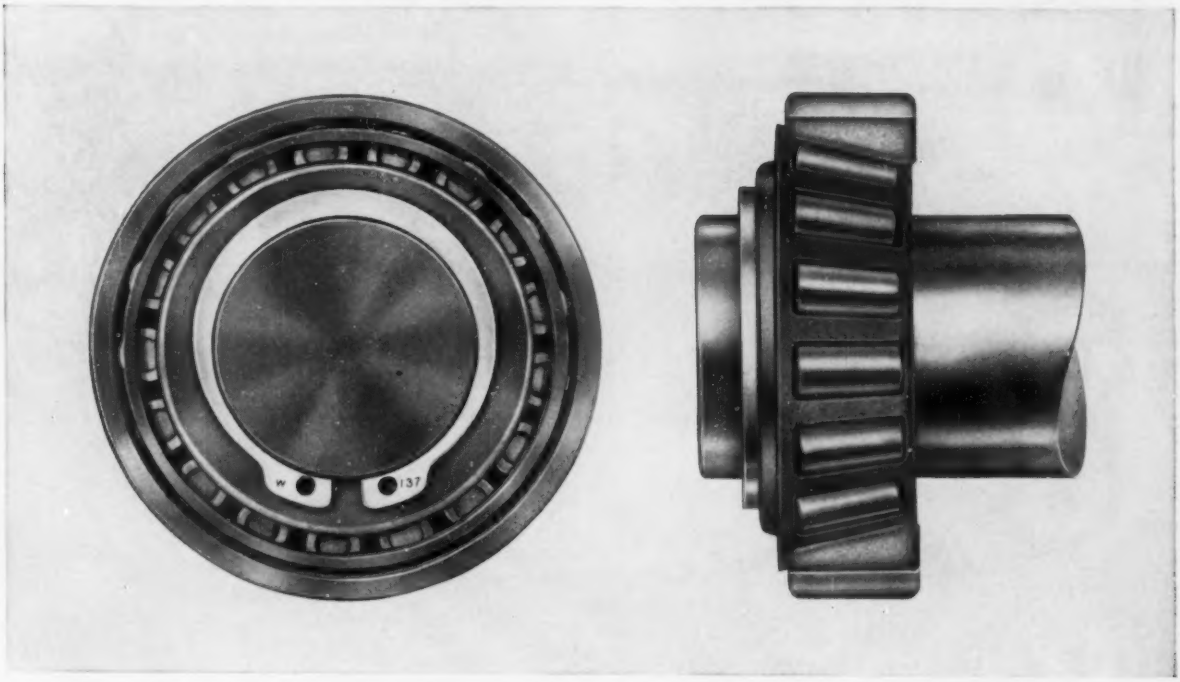

for thrust and impact...for retaining bearings ...for a new approach to heavy-duty fastening

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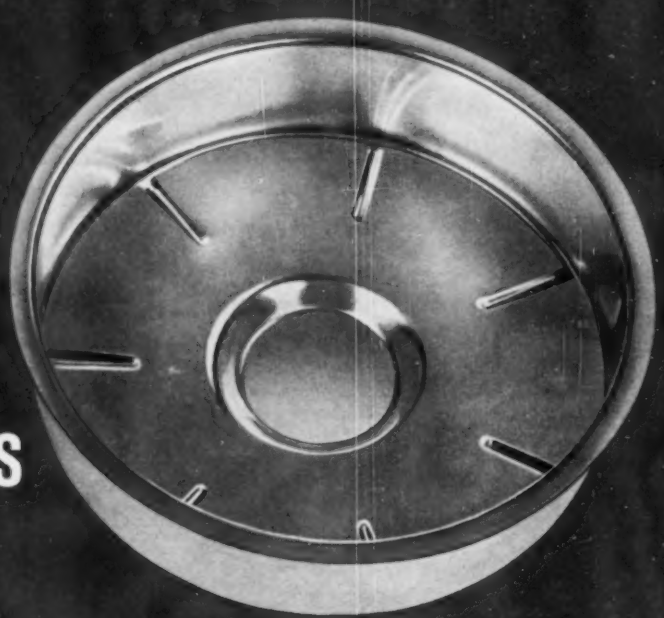

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Planning for the Future

The membership of ASTME has overwhelmingly voted in favor of the sweeping constitutional changes recently recommended by the Long Range Planning Committee. As this is being written, the officers, directors, and headquarters staff are finalizing reports to the Board of Directors and recommending various steps to implement the vast changes in our Society which will take place between now and 1975. In making our plans, we assumed that:

- Gross national product, which was 505 billion Jan. 1, 1961, would be over 800 billion in 1975.
- U. S. population of 179 million in 1960 would be 235 million in 1975.
- In all of the 1960's, 120 billion would be spent for research and development.

The handwriting is plain. Our Society will have no mean task paralleling the growth we will witness in our profession. But at no time in history have we faced a climate so favorable to our stated purpose.

As you read this, it is our hope the Society's directors will have approved the plans to prepare ASTME to grow, to serve its membership, and to cooperate with education and industry in meeting the coming technological changes. Our primary task will be to work with the educators so that they will be able to supply manufacturing engineers for industry.

Our Society was founded with the purpose of becoming the tool and manufacturing engineer's principal resource for keeping abreast of the rapidly expanding science of creative manufacturing; in other words, "World Headquarters for Manufacturing Know-How." To the degree that this science accelerates in growth and complexity, our Society must increase its service and consequently its value to the member.

This can only be accomplished through service to the membership of the Society to the fullest extent possible within the bounds of our Constitution. In so doing, the Society will serve industry and mankind throughout the world.

Your Society intends to aggressively pursue every avenue to become the dominant factor in shaping a favorable public opinion of your profession and to become recognized as world headquarters for manufacturing know-how.

W. Moreland

American Society of Tool and Manufacturing Engineers

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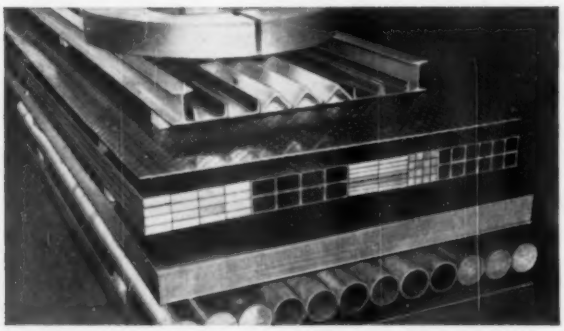

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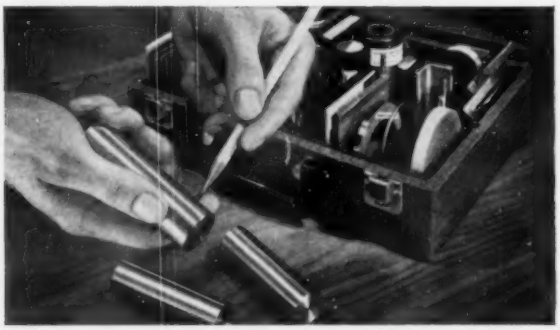

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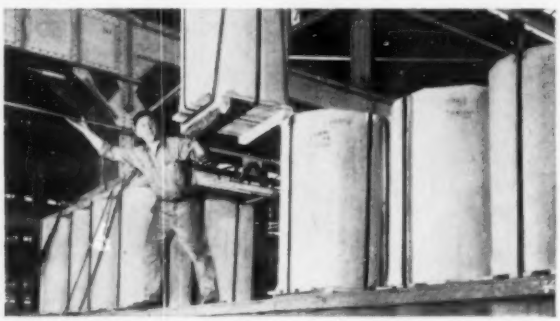

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RYERSON METALOGICS

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scheduling machines and manpower—

one chart gives answers

By Roy A. Williams
Industrial Engineer
Electronic Tube Div.
Westinghouse Electric Corp.
Bath, N. Y.

Simple charts often are useful for solving production problems. Estimating production time is no exception. The chart described in this article has proved economical without need for elaborate data processing equipment.

CAN YOU PROVIDE US with these parts? Do you have the necessary available hours of machine or operator time? Both of these questions sound familiar. They are asked frequently of the parts department or by the members of the production control group.

Meetings or conferences concerning the problem of scheduling often succeed in taxing the patience of the parts department foreman. Those asking questions usually want immediate answers. Even though a foreman may have complete knowledge of his organization, he is likely to be hard pressed for consistent answers without previous preparation or some type of referable aid. This can be especially true after continuous questioning.

The manufacturing engineering department can help these foremen with such problems by supplying information calculated to provide fast and consistent answers. Of course, any data offered to the production supervisor is only as valid as the backup material from which it is derived. Estimating is frequently a major portion of any complete plan and, when done often enough, becomes a very sensible and reliable part of the idea.

Graphs and charts can be extremely useful "tools" in the possession of the appreciative manufacturing supervisor. Through the use of these tools, quick, consistent answers are made possible. Quick, because the graphs and charts include the departmental variables in easy-to-read form. Consistent, because they are based on the same ingredients. Also, these graphs and charts are economical for there is no heavy investment in data processing equipment.

This is a typical problem: Industrial engineering was requested by a parts preparation department supervisor to supply information which would be

useful in determining the number of hours required to furnish a specified quantity of parts for a given schedule. This data was to be used in the schedule planning conferences to decide the capability of the parts department in providing the amounts necessary.

This foreman often found himself in the predicament, frequently experienced by other supervisors, of not being able to establish his departmental saturation point with regard to machine and operator availability. With aids, he was hoping to eliminate this problem and supply quick and reasonably accurate answers while at the same time maintaining control over availability.

The graphs and charts designed for this problem are simple in both makeup and usability. They require only minimum instructions to facilitate their assimilation into an accurate planning tool for the foreman.

Computing and compiling the material which constitutes a foundation for the graphs is basically a statistical operation. Although not complex, it involves time in composing the data and rendering it useful and applicable for graphic presentation.

Following are the chronological steps of approach:

1. Secure hourly rates of production for each different unit
2. Obtain from past records or estimate the number of units required to meet a given schedule
3. Combine this information into a "production factor" which can be applied to the graph
4. Construct an easily readable and usable tool.

Suppose there are 20 machines capable of yielding units of the same class but with a great many variations resulting from material, type, weight and thickness changes. These differences cause the machines to fabricate at a variety of speeds. Also, assume that the machines must make some 15 unit variations.

Now some of the units, even though unlike in specifications, are produced at the same quantity per hour and also are consumed by subsequent departments at the same rate. Actually then, there are the following conditions:

20 machines, one operator per machine
15 units to be manufactured
15 possible rates of production per hour
15 possible efficiency factors.

The plan is to group these parts, the result being as few categories as possible, with each category having a factor to be applied to the graph.

As an example, assuming there are two different products—*A* and *G*, made at hourly rates of 1600 and 1700, respectively. However, *A* is produced at an efficiency of 90 percent while *G* is somewhat lower at 85 percent. The result is that for all practical purposes to meet a given schedule, the same amount of hours will be required to manufacture these two different parts. Therefore, these two types can be combined under the same production factor.

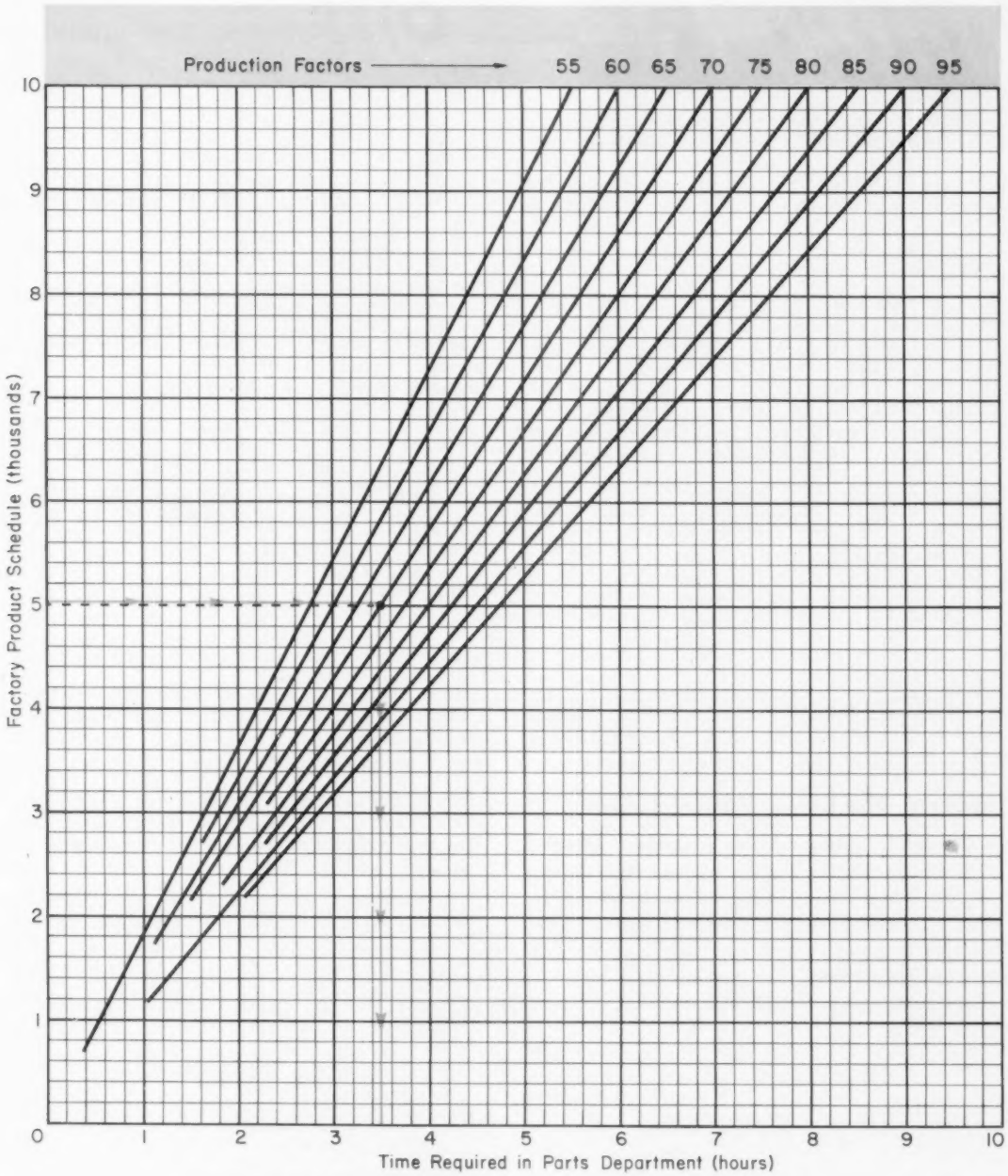
After completion of this portion of the job, the information is transferred to a graph to facilitate usage when different schedules, both in product variation and amount, are required.

Vertically on the graph, the scale is, "Amount of Factory Product," i.e., that unit which utilizes the parts department components. Horizontally, is the "Time Required in Parts Department" to supply a given amount for a specified schedule.

The factor lines are then applied. Because the

Worksheet to Determine Production Factors

Product Part Variations	Production Rate (parts/hr)	Time Per Thousand Units (hr)	Over-All Efficiency (%)	Calculated Production Factor	Production Graph Factor
A	1600	0.625	90	0.695	70
B	1200	0.835	90	0.927	93
C	2000	0.500	90	0.556	56
D	2000	0.500	90	0.556	56
E	1500	0.667	80	0.835	84
F	1200	0.835	85	0.983	98
G	1700	0.587	85	0.691	70
H	1700	0.587	80	0.735	74
I	2000	0.500	85	0.586	59
J	1500	0.667	80	0.835	84
K	1500	0.667	80	0.835	84
L	1200	0.835	90	0.927	93
M	1200	0.835	85	0.983	98
N	1600	0.625	85	0.736	74
O	1200	0.835	85	0.983	98



Production chart for quickly estimating time required to produce a given quantity of parts when over-all production factor is known.

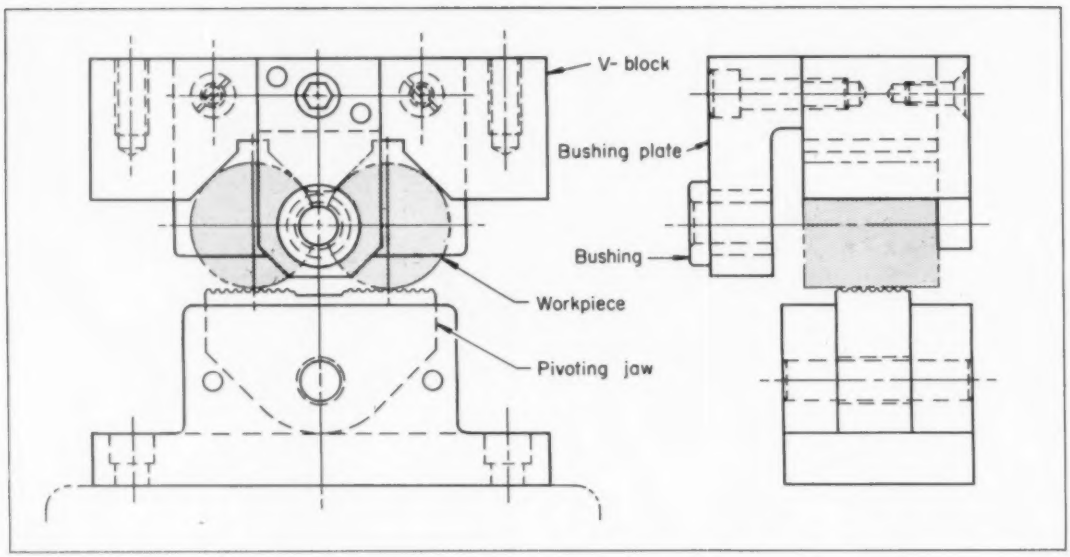
example depicted is based on hours per thousand units, the application of the factor, if the graph is designed correctly with factory product designated vertically in thousands, is simple. For instance, a certain number of hours is required for each thousand units manufactured. Consequently, the plotting of the points for a thousand units and say, ten thousand units, offers no problem.

For example, it is required to ascertain the time required to make 5000 parts of product *A*. Reference to the worksheet shows that the production factor for product *A* is 70. Reading horizontally on the Factory Product Schedule for 5000 units to the intersection with the production factor, shown as a diagonal line for 70, the vertical intersection shows 3.5. In other words, 5000 of product *A* requires 3½ hours to produce.

The simplicity of this tool in construction and comprehension makes it a worthwhile project. If satisfactory results can be obtained through its use, then certainly the effort expended in making such an instrument is justified.

Gadgets

Ingenious Devices And Ideas

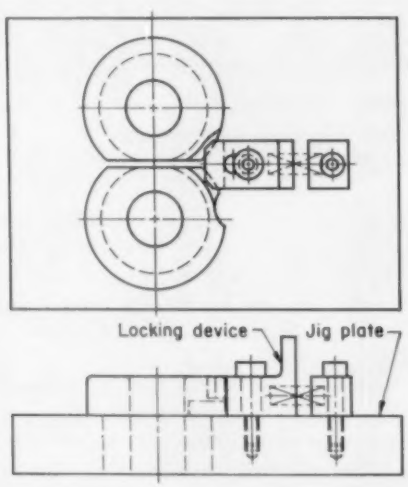


Fixture Machines Radial Grooves

Cylindrical parts requiring accurately machined slots are finished in double sequence with fixtures of this design. Intended for use in machine vises, the fixture makes use of a double V-block and a pivoting jaw which provides equal clamping pressure on both parts. The bushing plate holds an alignment bushing of conventional design, but drilling is accomplished with an end mill instead of a conventional twist drill.

Production is further increased when this setup is used on a drill press with an automatic feed. During machining, the operator is free to deburr parts finished in the previous cycle.

Roger Isetts, Kenosha, Wis.



Locking Device Holds Slip Bushings

When slip bushings are too close for conventional rotation and removal, they can be altered and used by means of this device. Alteration consists of grinding flats that extend approximately halfway through the lip. Clamping is then effected with a spring-actuated clamp that hooks over the remainder of the lip.

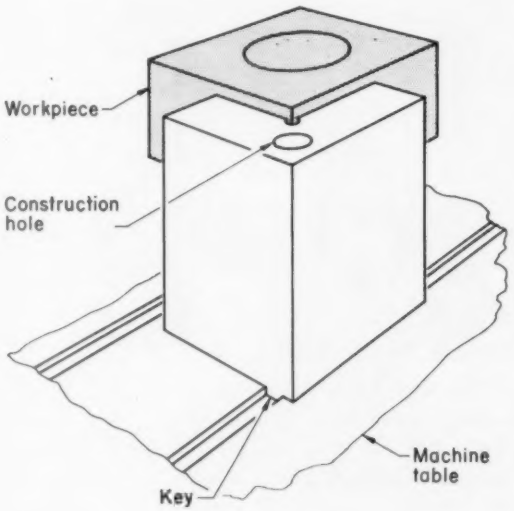
Donald A. Bruno
Racine, Wis. Chapter

Special Angle Plate Speeds Jig Boring

Jig-boring operations on small sections or parts can be expedited by use of this special angle plate. Principal benefit of the tool is that it eliminates the need for "rocking chairs" or gage-block setups in positioning the spindle relative to the workpiece edge. This is accomplished by indicating a construction hole located at known dimensions from the working surfaces of the angle plate.

In this tool, perfect alignment is attained by keying one edge of the plate to bolt slots in the table. This eliminates the necessity of aligning individual workpieces in relation to the machine.

Alfred Richter
Dallas, Texas

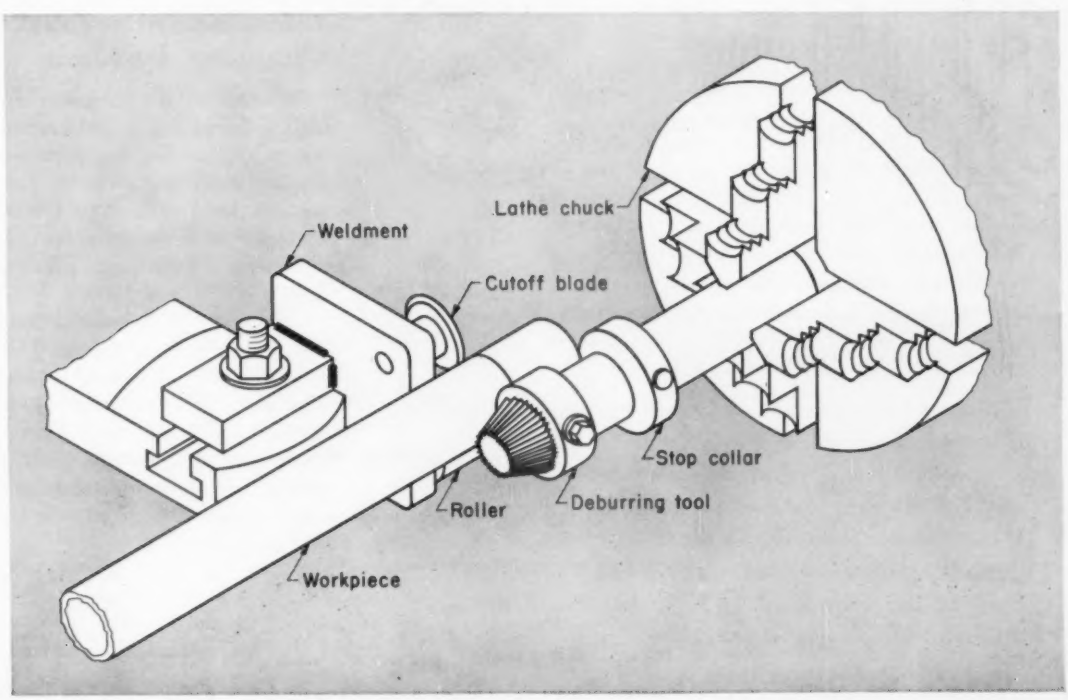


Lathe Tool Cuts and Deburrs

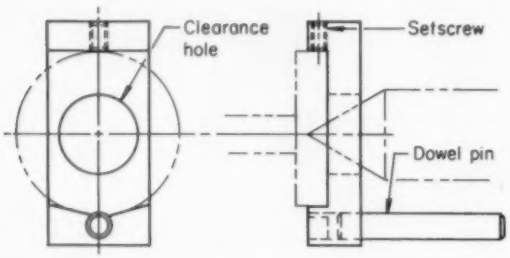
Cutoff and outside deburring operations are effected through application of this setup to a conventional lathe. Basic tools are a deburring tool and a weldment to which a drum type roller and a circular blade are appended. These units at one end, and a wooden block at the other, provide workpiece support during cutoff.

In operation, parts are cut off by feeding the circular blade into the tubing by means of the compound handle. After cutoff, the end of the tube is backed up and rotated against the deburring tool for burr removal.

Ernest Jones
Bronx, N. Y.



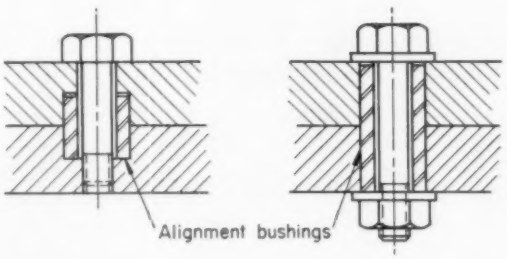
Gadgets



Special Dog For Turning Small Shoulders

Essentially a V-block, this dog is an effective solution to the problem of driving parts with relatively thin shoulders between centers. Clamping is accomplished with a small setscrew which holds the workpiece in the Vee. A clearance hole machined in the dog permits entrance of the machine center and a conventional dowel pin is used to drive the assembly.

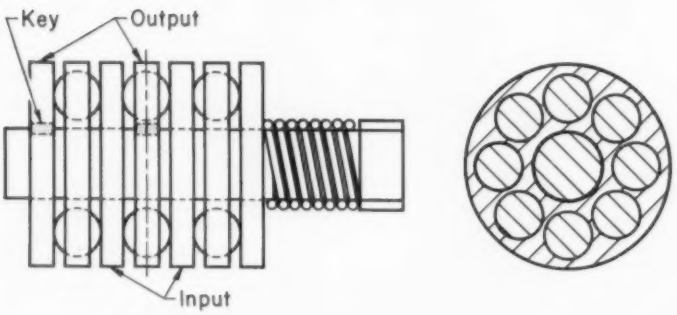
Henry Perina
Chicago Chapter 5



Bushings Maintain Alignment in Assembled Parts

Proper alignment of two components can be maintained by hardened steel bushings inserted in oversized fastener holes. As shown in this illustration, two methods of alignment are possible. In cases where one component is tapped, counterbored holes containing a small bushing are used. In cases where through hole fasteners are used, the bushing holes are jig bored or reamed through both components. In all cases alignment is maintained with dowel-pin accuracy.

Federico Strasser
Santiago, Chile



Miniature Differential Eliminates Backlash

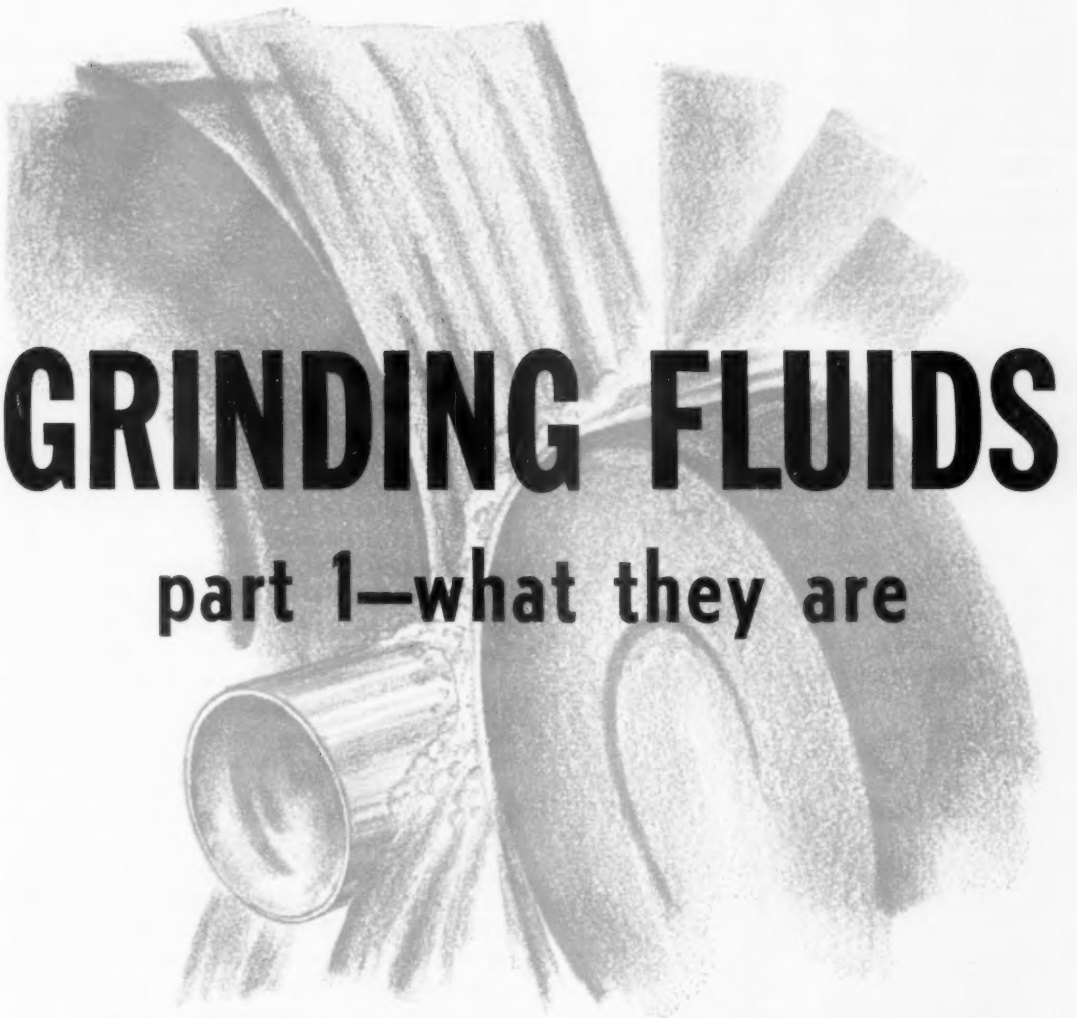
Differentials of this type are finding increased use in machine design applications that require a complete absence of backlash. They are also lower in cost and more adaptable to miniaturization than conventional bevel gear differentials.

Components include seven disks and 24 steel balls arranged as shown. Input is provided by the third and fifth disks: output by the first and fourth, which are fixed to the shaft. The seventh disk, a spring and nut are utilized to provide requisite pressures to the entire assembly.

C. Gibbons
Kings Co., N. S.

HOW DID YOU DO IT?

Remember the time you had a tough production problem? And you solved it by designing an ingenious bit of tooling? How about sharing your solution with fellow ASTME members? Send in your Gadget—a brief writeup and pencil sketch will do—to Gadgets Editor, THE TOOL AND MANUFACTURING ENGINEER, 10700 Puritan Ave., Detroit 38, Mich. If your Gadget is published, you'll receive an honorarium.



GRINDING FLUIDS

part 1—what they are

By L. P. Tarasov

Research and Development Dept.
Norton Co.
Worcester, Mass.

Little information has been available in the past to aid manufacturing engineers in selecting fluids for grinding operations. The functions and the general nature of the various types of fluids are explained in this authoritative article of a three-part series. Subsequent articles will deal with their effects on grinding action and with the principles involved in selecting and using the fluids.

PRACTICAL EXPERIENCE over many years has shown that some grinding operations can be performed dry, others require the use of a water-base mixture or solution and still others need a grinding oil. In general, waterbase compounds are used when the work would otherwise become too hot, and oils are employed when maintenance of a highly accurate wheel shape is essential, as in form grinding.

Because water is an excellent cooling medium, water-base compounds are frequently called coolants. This is not a satisfactory term because it focusses attention on a single function to the exclusion of others which may actually be much more important. The same applies to calling a grinding oil a lubricant. A more suitable term is grinding fluid, which describes the general nature of the substance without defining how it is supposed to function. Moreover, this term is broad enough to include not only water-base compounds and grinding oils but also air itself, which has a pronounced effect on grinding action and will be discussed later

in this article.

Grinding fluids are essentially cutting fluids used in grinding operations. Often the same fluids can be used for both machining and grinding.

Some grinding fluids are modifications of products used previously for machining only. Likewise, there are fluids that have been developed specifically for difficult grinding operations that have subsequently been found suitable for machining applications. Much of the published information on grinding fluids has considered them as a special case of cutting fluids and the result has been that most of the attention has been devoted to their behavior in machining applications. In this article, grinding aspects only will be treated.

Studies of grinding operations in which the fluid is a variable are likely to involve proprietary products. Since the available information about the composition is frequently general in character, it is usually difficult to establish definite relationships between the observed grinding action and the ingredients comprising the fluids. Thus it is not surprising that contradictory ideas are expressed at times as to what is needed in a grinding fluid for a specific operation.

For example, experiments conducted some years ago by one manufacturer of cemented carbides indicated that grinding them with a silicon carbide wheel was best accomplished when the fluid contained a wetting agent, but another manufacturer came to just the opposite conclusion. In all likelihood, these opposing opinions were based on studies in which different types of wetting agents or other chemical additives were involved. Similar differences of opinion have been expressed concerning the desirability of grinding hardened steels with a highly active sulfochlorinated grinding oil.

Table 1—Types of Grinding Wheel Wear

Type	Characteristic
Attritious	Development of flat areas on abrasive grains formed mechanically or chemically
Grain fracture	Formation of new cutting edges
Bond fracture	Eventual loss of remaining grain

Even with the limited information that is available about the compositions of most grinding fluids, considerable progress has been made in recent years toward improving our understanding of the ways in which they may affect grinding action[1]. The usefulness of a grinding fluid depends not only on its behavior in the immediate vicinity of grinding contact but also on how it functions away from this region. Both aspects must be considered in the selection of a fluid.

[1]References are listed at the end of the article.

The Grinding Process

Wheel Wear: In order to get a clear picture of how a fluid may function at grinding contact, it is necessary to consider briefly the nature of the grinding process. Grinding is a special type of machining operation, in which a large number of irregularly shaped abrasive particles, bonded in a wheel, remove extremely thin and narrow curly chips. These are similar to the chips obtained in milling but are far smaller in size. In this sense, a grinding wheel acts the same as a milling cutter, but there is a vital difference between the two with respect to wear. In machining with tools having a fixed geometry, wear is undesirable because the tool becomes dull so that it has to be resharpened or discarded. In grinding, however, a certain amount of wear is generally needed to maintain the sharpness of the abrasive grains.

Several types of wear occur during grinding, and these are summarized in TABLE 1. An initially sharp abrasive grain will gradually develop a small flat which increases in size by attritious wear until the frictional force between this surface and that of the work becomes sufficient to fracture a small portion of the grain and create a new cutting edge. This cycle of attritious and fracture wear goes on until the bond posts holding the remainder of the grain in place have been weakened enough by the repeated impact forces to release the grain. Thus, there are three types of wear: attritious wear of the grain, grain fracture, and bond fracture.

Of these the first can be not only mechanical but also chemical in nature, as has been shown in various ways. It is an undesirable type of wear because the flats on the grains result in a dull or glazed wheel surface, and thus generate excessive heat. Wear by fracture, on the other hand, is desirable to the extent that it keeps the wheel face sharp and cool cutting. In actual practice, other considerations also enter into wheel selection, and it may be necessary to use a hard wheel in order to preserve accuracy of form, as in thread-grinding. With such a wheel, proper cutting action has to be maintained by means of frequent dressing.

Since several unrelated types of wear are involved, which take place more or less simultaneously in the various grains that are in suitable positions to cut out chips and, since the cutting portions of the grains are completely random in shape, the mechanics of the grinding operation is extremely complicated and can be analyzed only on a statistical basis.

Moreover, the condition of the wheel face, which affects the grinding action, depends not only on the

geometrical characteristics of the abrasive grains but also on the foreign matter which may be present as a result of loading or gumming. Loading occurs when particles of the material being ground become firmly attached to the abrasive grains or become trapped in the pores of the wheel. Gumming refers to the contamination of the wheel face by sludge or gummy material resulting from the breakdown of the grinding fluid.

Generation and Removal of Heat: Wheel wear and heat are the two characteristics by which grinding performance is judged in most operations, but surface finish may also play a significant role in the evaluation. Wheel wear is important not only because it has a direct bearing on wheel cost but also because it can have an important effect on the time required to grind a satisfactory part. If the wheel wears too rapidly, it may be difficult or even impossible to meet the tolerance requirements. On the other hand, a wheel that wears too slowly will require frequent dressing to maintain its cutting action so as to prevent the generation of excessive heat in the work surface. In studies of factors affecting wheel wear, this quantity is most conveniently expressed in terms of the grinding ratio, which is defined as the volume of material removed per unit volume of wheel wear. Thus low wheel wear corresponds to a high grinding ratio.

As in any chip forming operation, heat is generated during grinding. Excessive heat can damage the work both dimensionally and physically. Examples of the former are warping and local thermal expansion of the part so that a heavier cut is taken than planned. Physical damage includes microstructural changes, such as softening or rehardening of hardened steel; cracking, generally of hard materials; and undesirable residual stresses, which can lead not only to warping and cracking but also to a reduction in fatigue strength.

Most of the heat generated in grinding is absorbed almost immediately by the cold metal underneath the surface, which acts as the primary cooling medium. Some of the heat goes into the chips and the wheel. The externally applied grinding fluid, whether it is a liquid or a gas, cannot remove a significant amount of heat from the work at the instant it is generated because heat transfer through an interface is relatively slow compared to heat flow into the adjacent cold metal. Only after the heat has been absorbed by the metal does the fluid have time to remove it from the work.

This was shown by a simple experiment in which two pieces of hardened steel were severely surface ground under exactly the same conditions except that one piece was ground dry and the other wet. The depth to which they were burned, determined by metallographic examination, was essentially the same, showing that the heat generated in grinding flowed into the steel and softened a layer several thousandths of an inch deep before the surface could be cooled externally. The work then cooled more rapidly in water than in air but only after the surface layer had been damaged by the momentary high temperature.

Although grinding fluids cannot immediately remove the heat generated in grinding, they can affect both the amount of heat generated and the speed with which the work can be cooled to room temperature after it has first absorbed the heat. Heat generation and heat removal are two entirely different aspects that have to be considered in evaluating grinding fluids.

In a hardened steel that is ground severely enough to be burned, the depth of burn provides a measure of the heat that goes into the work. Since the depth of burn is related to the net power consumed by the motor driving the grinding wheel, the heat absorbed by the work can be conveniently expressed in terms of the net power. The method is not accurate but it is satisfactory enough from a practical standpoint for rating wheels or fluids with respect to the heat developed in the work.

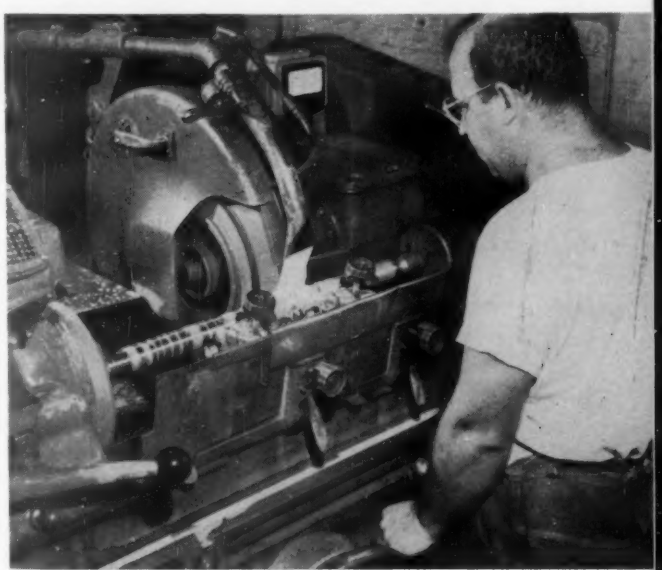


Fig. 1. A water-base fluid removes heat rapidly.

Desirable Grinding Conditions: It is obviously desirable to have simultaneously a high grinding ratio and a low power consumption, provided the other aspects of the operation are satisfactory. In most cases, this is accomplished by the selection of the proper wheel specification but, when the material or the workpiece happens to be difficult to grind, the choice of a suitable grinding fluid may be highly important.

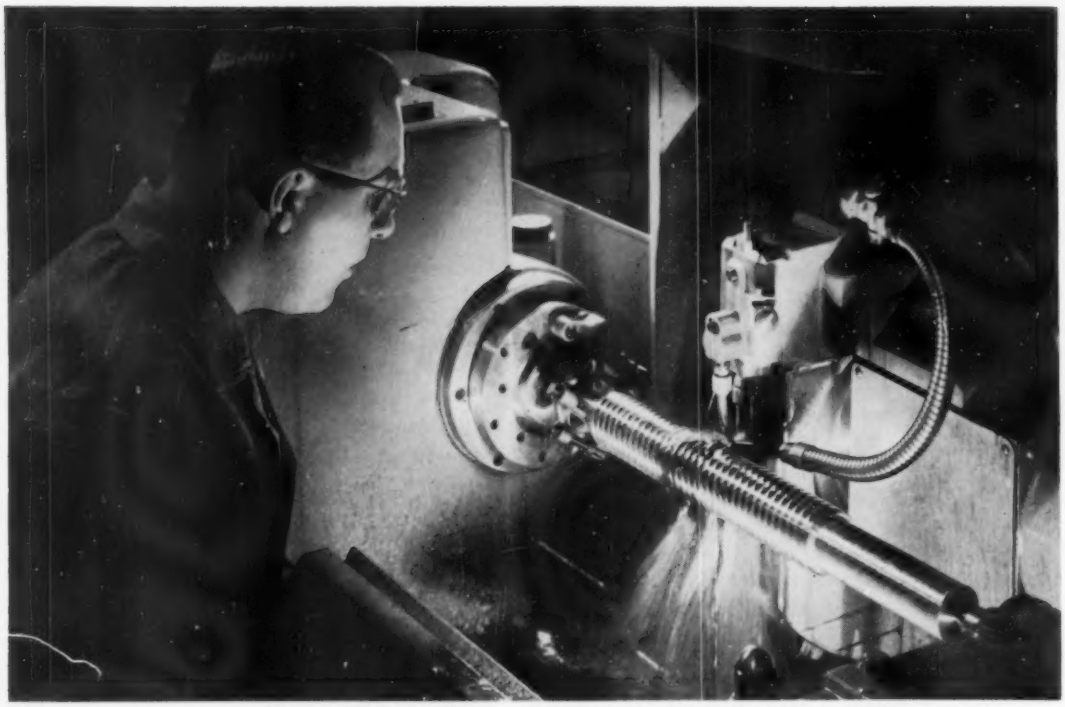


Fig. 2. An oil is needed for maintaining accurate wheel form in thread grinding.

An increase in the grinding ratio is particularly useful when it is low enough to cause operating difficulties as a result of a high rate of wheel wear, but not when the wheel is wearing satisfactorily. The relative sizes of the wheel and workpiece may determine whether an increase in the grinding ratio would be of any value, since a low ratio may lead to trouble in meeting the required tolerances when the work is large and the wheel is small, but not when the situation is reversed. A reduction in the net power consumption is likewise primarily advantageous when the problem is excessive heat generation for the work material involved, but it can be helpful even when the power is satisfactorily low to begin with, if a further reduction permits heavier cuts to be taken without exceeding a safe value.

Classification of Fluids

General Functions and Types: The usefulness of a grinding fluid depends not only on its composition but also on the work material and the grinding operation. Since a fluid can perform a number of different functions, their relative importance will depend on these factors. Maintenance of a satisfactory wheel face is, of course, always important since conditions like glazing, loading and gumming will result in the generation of excessive heat. When wheel wear is too high for the operation, the ability of a fluid to reduce this substantially is a highly desirable property.

A fluid may also be called upon to remove heat rapidly from the work as well as to help in producing a good finish, *Fig.* 1. An important function of a fluid is to remove the chips from the vicinity of the work and to keep them from being recirculated by the fluid.

In addition, the service properties of the fluid, or its behavior away from the area of grinding contact, must be satisfactory since poor performance in this respect can rule out the use of a fluid even though it has a highly beneficial effect on the grinding action. Essentially, it should be stable, both physically and chemically, and should not be detrimental to anything with which it comes into contact.

Undesirable characteristics, either in use or when the machine is standing idle, include breakdown of an emulsion; bacterial growth and resulting odor; foaming; corrosion of the work or machine; weakening of the wheel bond; softening of paint; formation of a hard or gummy deposit on the machine or of a deposit which can short circuit a motor; low flash point for an oil; and harmful or unpleasant effects with respect to the operator. Even a fluid that is unsatisfactory from the operator standpoint can be used if it is kept from him by means of a suitable enclosure and exhaust system. These service aspects will be discussed in connection with the selection of grinding fluids. Grinding fluids have been classified in several ways[1,2,3] but they all fall into the following general groups: grinding oils,

soluble oils, chemical fluids, and gases. Solids that become liquid at grinding contact can perform some of the functions of grinding fluids.

Grinding oils are mineral oils that contain various additives to improve the grinding action. So-called soluble oils are water emulsions of petroleum products, while chemical fluids, also called synthetic, are water emulsions or solutions that do not contain mineral oils. Various additives are likewise incorporated in the water-base fluids to make them perform satisfactorily. Some such fluids are mixtures, in various proportions, or soluable oils and chemical ingredients.

Gases are exemplified by air, which is present in all dry-grinding operations, and by carbon dioxide. The impregnation of a grinding wheel with solids possessing lubricating properties, and the external application of a grease stick, are ways of providing some degree of lubrication when it is needed but the operation has to be performed dry, as in offhand grinding of soft, gummy metals. In special cases, as in certain types of knife grinding, the wheels are treated with sulfur to produce a cooler grinding action. For these they are used wet.

Grinding Oils: These reduce the heat generated and make it possible to use the hard wheels that are required when maintenance of an accurate form is essential, as in thread grinding, *Fig.* 2. They usually contain fatty materials of various kinds to provide the desired wetting and lubricating action, and they may also contain sulfur or chlorine or both. Such additives may reduce wheel wear. They may also reduce the heat generated in the surface of the work, either directly or by preventing the wheel face from becoming loaded. In the latter instance, the surface finish is likely to be improved.

Grinding oils are generally classified as active or inactive, the distinction being based on whether or not a copper strip is darkened by being exposed to the oil for three hours at 212F. This darkening occurs if the oil contains sulfur in a form sufficiently active to react with copper under the stated conditions. Highly active oils will blacken copper immediately at room temperature. The degree of activity can be determined quantitatively by reacting the oil with copper powder at 300F.

Inactive grinding oils consist of mineral oil to which fatty materials of various kinds are added in nearly all cases. Although no sulfur is added, some may be naturally present in the original oil, but this sulfur is too firmly attached to the oil molecules for it to react with copper.

If the fatty material in such an oil has been treated with sulfur, the grinding oil is still considered to be inactive in terms of the copper staining test, but from the grinding standpoint it may show some definite chemical activity at the point of grinding contact, as determined from its grinding performance. The fatty material in such an oil may also be chlorinated.

The active oils are those in which the active ingredient, sulfur or chlorine or both, is present in the oil phase, either forming part of the oil molecules or part of a compound dissolved in the oil. The sulfur or chlorine atoms are not attached too firmly to the molecules in which they are located so that they are released readily at fairly low temperatures. Most of the active oils contain both elements, but there are some in which sulfur only is present, and a few that contain a considerable percentage of chlorine but no sulfur. Fatty materials, which may or may not have been treated with sulfur and chlorine, are also present in the active grinding oils.

The division of grinding oils into just two categories can lead to confusion when it is not realized that the conventional tests for activity, conducted at relatively low temperatures, do not necessarily predict the activity at grinding contact which is at a much higher temperature. When an inactive grinding oil containing sulfurized fatty materials provides much better grinding action than a similar oil free from added sulfur, the former can hardly be considered inactive from the standpoint of the grinding operation. It might be more appropriate to describe it as a moderately active oil. Another way that has been used to describe the activity of grinding oils is to call them hard, medium or soft, corresponding to active, moderately active or inactive[4].

Table 2—Simplified Classification of Grinding Oils

Type	Mineral Oil	Fatty Material
Inactive	N	N
Moderately active	N	T
Active	T	N or T

N = Not treated with sulfur (S), chlorine (Cl) or other extreme-pressure additives.
T = Mineral oil treated with S, S and Cl, or Cl; fatty material treated with S, or S and Cl; in a few instances, phosphorus or lead have been used.

Likewise, the performance of active oils does not necessarily follow their relative activity as determined by the staining of copper. The sulfur in a dark oil, frequently thought of as the most active of oils, is so loosely held that it stains copper immediately at room temperature. A transparent oil may contain even more sulfur but since this is held much more strongly within the molecules, the oil does not react with copper at room temperature or even at a somewhat higher one. At the temperature of grinding contact, however, the transparent oil can be even more active than the dark oil be-

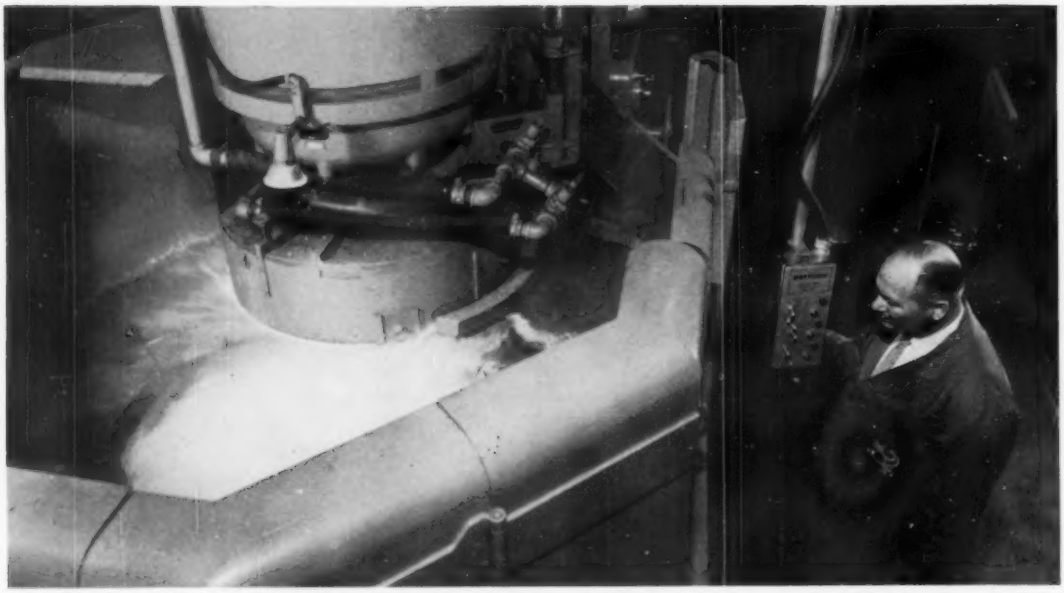


Fig. 3. A chemical solution is often used on steels and cast irons when the area of grinding contact is large.

cause more sulfur becomes available. These examples show why statements about the activity of grinding oils can lead to erroneous predictions as to their relative grinding performance.

A simple way of classifying grinding oils according to the principal type of ingredients is shown in TABLE 2.

Water-Base Fluids: In diluted form, soluble oils are water emulsions of petroleum products and may contain a large variety of ingredients. The basic materials in the concentrated product include the mineral oil, an emulsifier and a coupling agent whose function is to aid in the emulsification of the oil. Some water is also present to assure proper emulsification of the concentrate when it is diluted for use in the grinding machine. In addition, the soluble oil may contain fatty materials, soaps, sulfur and chlorine to aid in the grinding action. Other ingredients are added to improve the service characteristics of the product. These include surface-active agents to enhance the wetting action and detergency of the fluid and to prevent foaming; rust inhibitors, organic and inorganic; water conditioners for hard water areas; and germicides.

Because so many ingredients may be present in a commercial soluble oil, they have to be carefully balanced to prevent instability of the emulsion and other undesirable effects that may otherwise occur. The hardness of the water used in making the emulsion is an important factor. The soluble-oil composition may have to be modified by the supplier to match the water supply. Because of the delicate balance likely to exist between some of the ingredients, it is obviously undesirable to mix different brands of soluble oil.

In view of the inherent complexity of soluble oils, little is known about the ingredients present in any particular brand. However, it is possible to divide soluble oils into two main categories. The regular soluble oils consist primarily of an emulsified mineral oil but they may also contain soaps, fatty materials or both. The heavy-duty soluble oils are based on mineral oil that has been treated with sulfur and frequently also with chlorine. They normally contain fatty materials, either plain or treated with the previously mentioned elements. Such treatment of the fatty materials improves the detergency of the emulsion and thus helps keep the wheel face clean.

Paste compounds, which historically preceded soluble oils, are generally classified with the latter because of the similarity in appearance after they are mixed with water. These compounds consist primarily of soaps with smaller amounts of fatty materials. Mineral oil may also be present, as well as other types of ingredients found in soluble oils. They are more difficult to mix with water than are soluble oils and are now used very little by comparison.

The chemical (or synthetic) fluids, defined as water emulsions or solutions in which little or no mineral oil is present, can contain a wide variety of organic and inorganic materials. The chemical emulsions are based on organic substances such as waxes. They may also contain fatty materials, as well as added sulfur or chlorine. Other types of organic materials, like amine soaps, are found in

chemical solutions. Sal soda, which was used to prevent rust and to improve grinding action long before paste compounds or soluble oils were invented, is an example of an inorganic material which forms a chemical solution with water. It has been superseded for this purpose by another inorganic material, sodium nitrite. Broad-contact operations, like vertical-spindle grinding of steels and cast irons, are often done with chemical solutions, *Fig.* 3.

From the standpoint of most applications, the chemical fluids can be conveniently considered as falling into two general categories. The majority contain wetting agents and possess relatively good lubricity. The others do not contain wetting agents and are likely to have little or no lubricity. Most rust-inhibitor solutions for grinding fall into the second classification. They may contain passivators, such as nitrites, which react chemically with the work surface, or polar substances which form protective molecular films.

Gases: That air is an extremely potent grinding fluid is shown by some surface-grinding experiments in which the grinding forces were found to be many times greater when the operation was performed in a completely inert atmosphere than in air[5]. In the inert atmosphere, the freshly formed work and chip surfaces remained so clean that the chips welded back to the finished surface and had to be ground off a number of times before they managed to get away without touching the surface. In air, however, the oxygen immediately oxidized the clean surfaces and prevented any welding action. This example clearly illustrates the importance of some kind of chemical activity that can immediately contaminate the freshly formed surfaces with extremely thin films that prevent welding.

The other gas of interest in connection with grinding operations is carbon dioxide. Being inert, its only function is to cool the work, which it does effectively because it is cold as a result of expansion that occurs when it comes from a tank under high pressure. It was tried extensively for a short time but the economics of the operation proved to be unfavorable so that it is no longer used to any significant extent.

Transparency Characteristics: The transparency of a grinding fluid can be a factor in its selection if it is desirable for the operator to see the work in the immediate vicinity of the wheel. When highly active grinding oils were first introduced, they were black and opaque because of the manner in which the sulfur was present in the oil. With the newer methods of introducing sulfur into the oil, it is no longer necessary to sacrifice transparency to have a high degree of activity.

Water-base compounds can vary from the milky or opaque to the completely transparent varieties, depending primarily on the size of the particles present in the water. An emulsion consists of small particles of one liquid dispersed in another. The individual droplets in soluble-oil emulsions are generally in the range of 40 to 200 microinches in size, and somewhat smaller in chemical emulsions. Since the wave length of visible light is from 16 to 28 microinches, the droplets in these emulsions are large enough to absorb light partly or completely so that the emulsion is translucent or opaque. The particles are of the order of one microinch in colloidal chemical solutions and of molecular dimensions in true chemical solutions. They are thus many times smaller in diameter than the particles in emulsions. As a result of the small particle size, the solutions are transparent.

One reason for grinding dry, when this is feasible, is to give the operator the best possible view of the work, especially when a contour is being ground. Carbon dioxide is used for the same purpose when greater cooling is needed, yet a liquid cannot be used because optical equipment for determining the contour is mounted on the machine.

References

1. H. W. Wagner—"Grinding Fluids—Characteristics and Applications," *Mechanical Engineering*, Vol. 73, Feb. 1951, p. 128-132.
2. A. W. Ackerman and F. E. Anderson—"Chemical Machining and Grinding Fluids," ASLE Annual Meeting, April 1956; also A. W. Ackerman—"Cutting Fluids," ASTME Technical Paper 141, 1958.
3. E. C. Enos—"Know Your Grinding Fluids," *Grits and Grinds*, Vol. 51, No. 1, Jan. 1960, p. 7-13.
4. E. L. H. Bastian—*Metalworking Lubricants*, McGraw-Hill Book Co., 1951, p. 43.
5. J. O. Outwater and M. C. Shaw—"Surface Temperatures in Grinding," *Transactions ASME*, Vol. 74, 1952, p. 73-86.

"Today we'll practice the blank inscrutable expression for use in management conferences."

designed for

PRODUCTION

Transfer System Moves Parts Between Machines

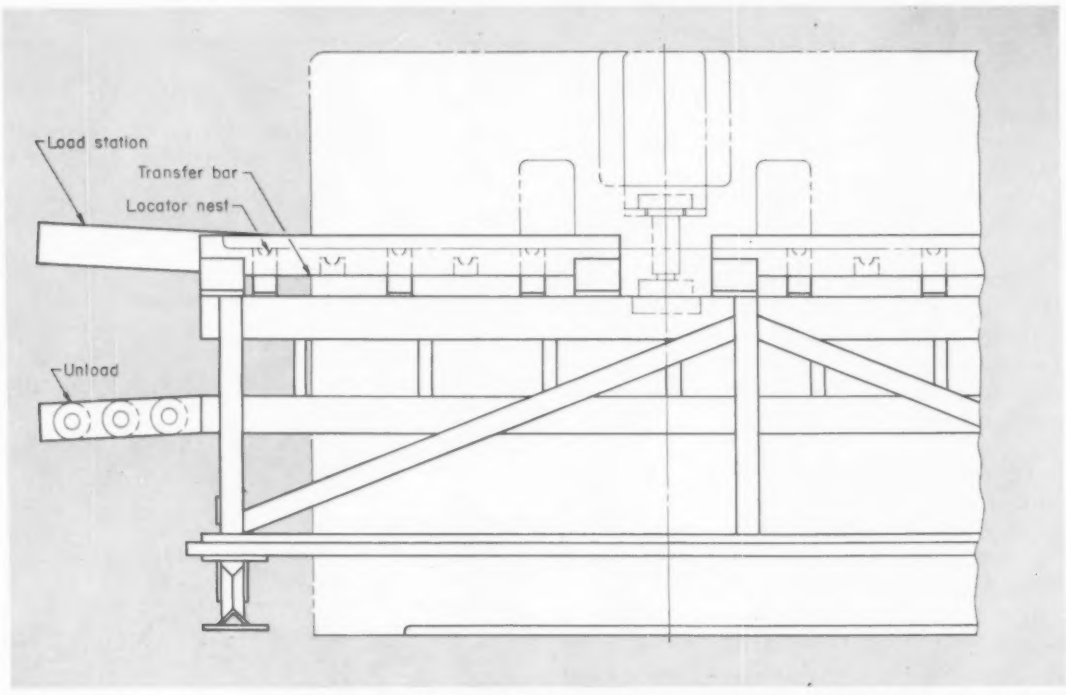
Designed to move differential pinions through two machines—a thread roller and spline roller—this system utilizes a series of lift-and-carry units to effect part transfer.

During the machining cycle, the pinions are located in a series of locator nests, each of which is comparable to an idle station in a transfer line. When a machining cycle has been completed, all pinions are advanced one station. Arriving at the last station, they are rolled to a lower level and returned to the point of origin.

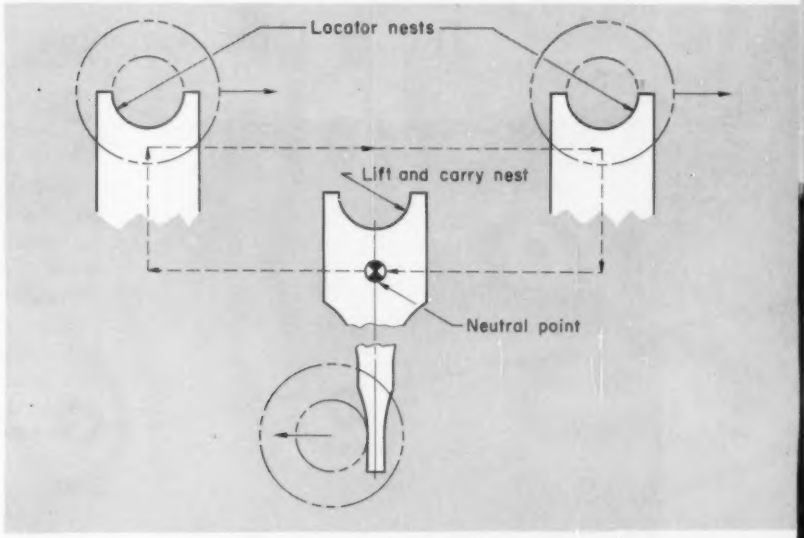
Movements of each pinion between cycles is effected by a transfer bar that moves in a rectangular path. Starting at a neutral point between two stations, each rest moves left to a point under a locator bar. At this point it elevates, seizes a part and raises it out of its locator. Moving to the right, the transfer bar stops at a position directly above the next station and descends, depositing the part in the locator. It continues its descent and then moves left to the neutral starting point.

Parts lowered to the return track are moved by a finger that extends downward from the transfer bar. In this way, each movement of a part on the upper track results in a corresponding part movement on the lower track.

This system was designed and built by the Gear-O-Mation Division of Michigan Tool Co.

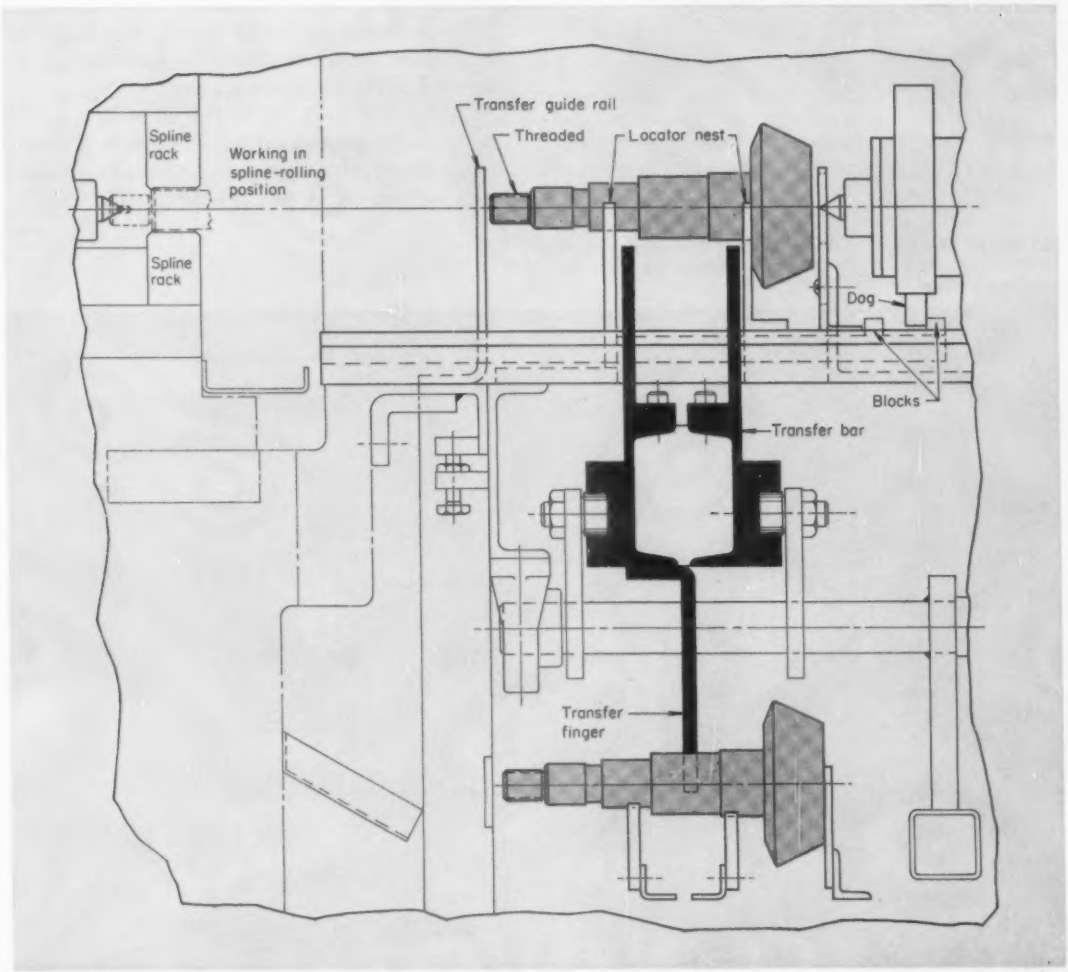


SECTION VIEW of a transfer bar at a spline-rolling station. At the start of the machining cycle the headstock (at right) advances and positions workpiece in the machine.

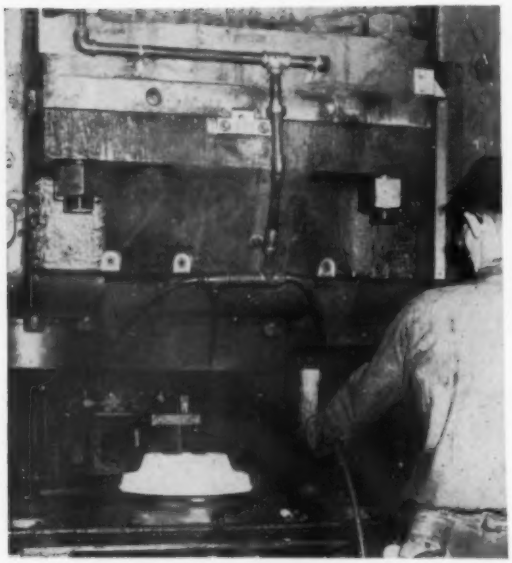


SCHEMATIC DRAWING of rectangular path taken by the transfer bar in moving a workpiece. Neutral point indicates rest position during machining.

SCHEMATIC DRAWING (below) of entire machining unit. Transfer system is designed to unite two conventional machines into a single production line.



Transfer Units Automate Forging Press



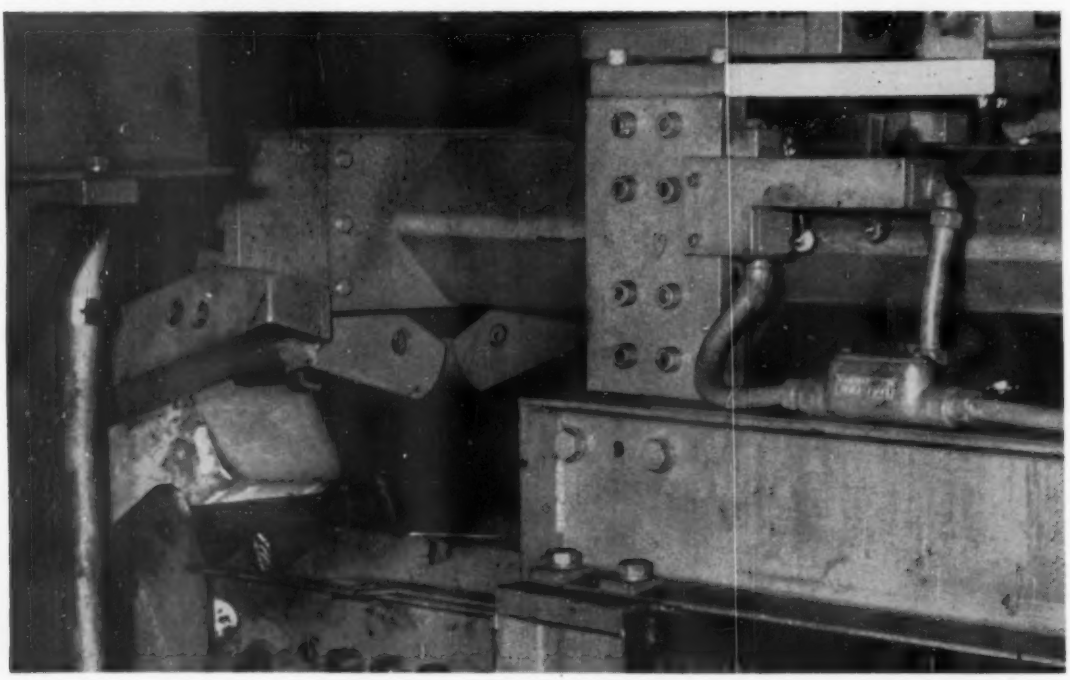
TRANSFER UNIT placing forging in final form die. Jet sprays cool and lubricate dies during transfer cycle.

Automatic feeding and part transfer from die to die make this press, in effect, an automated forging line. The press and transfer unit are installed at Eaton Mfg. Company's Marion, Ohio plant. In operation, billets heated to 2400 F are transferred from a slide conveyor to the press by a hydraulically operated two-slide unit. The upper slide picks up the billet from the conveyor, rotates it 90 deg and places it on the lower slide. The lower slide advances, placing the billet in the first die.

After the press cycles, the billet, converted by the first die to a rough approximation of final shape, is picked up by the in-press transfer unit and moved to the second die in the sequence. Pickup is made on a small boss protruding from the center of the part. In the event the part is out of place at any part of the cycle, a "fail-safe" logic and output system (Norpak) stops all press and transfer activity. This is accomplished by controls that are activated in the workpiece gripper.

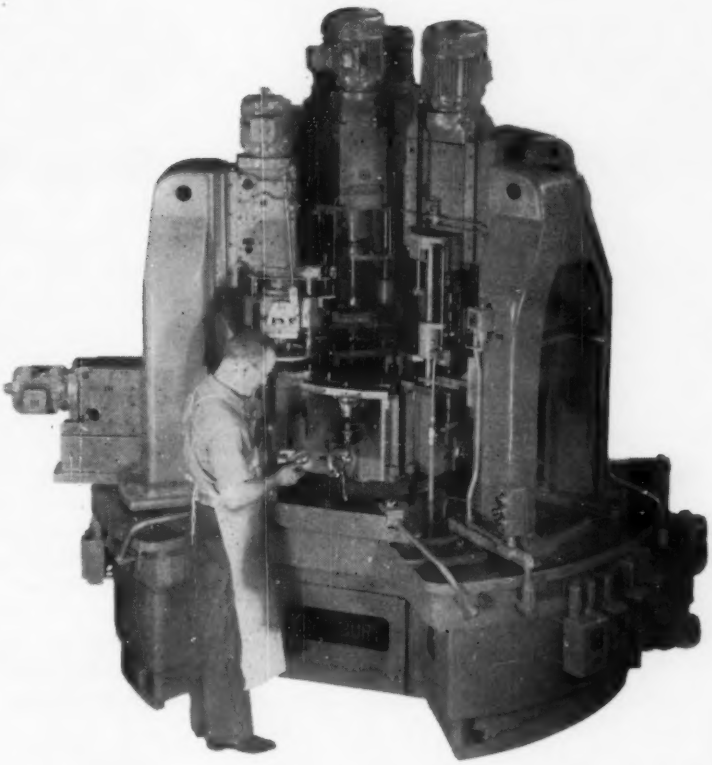
Because the third die in the three-die sequence performs the greatest amount of work, it is located in the center of the press bed. Thus the transfer cycle is from right to left to center and out.

HOT BILLET in 90 deg rotation (below) for placement in first die. Rotation of the billet is effected by pivoting cradle mounted on the lower slide.

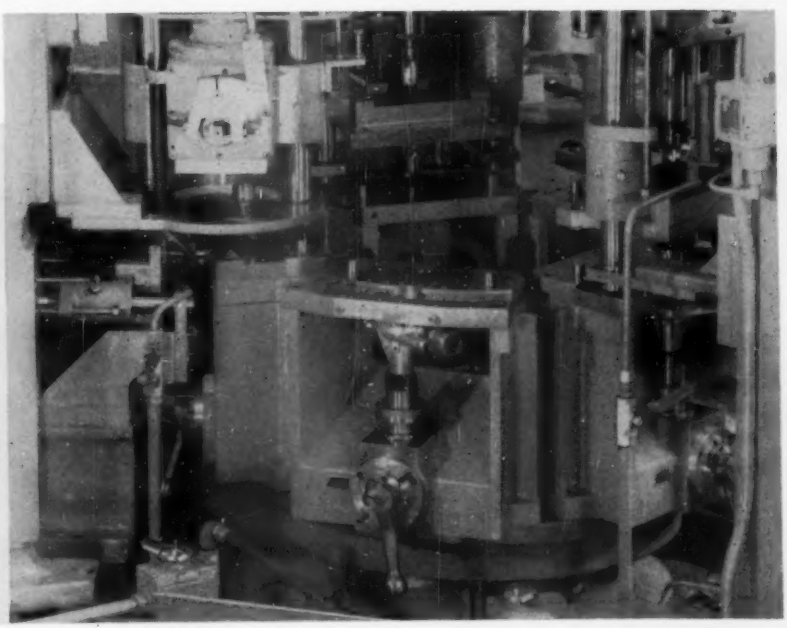


Oscillating Cutter Removes Flash

An oscillating milling spindle removes flash from water-pump housings in the first station of this Kingsbury indexing machine. Required oscillation is provided by a cam that activates a lever at the side of the machine head. This lever, in turn, rotates a rocker arm mounted at the side of the milling unit. Movements of the rocker arm—adjustable to provide desired strokes—rotates a shaft to oscillate the spindle.



SIX-STATION indexing machine in operation. Lever and rocker arm are visible on the unit directly above the operator.



CLOSE-UP of load station and oscillating station. Workpiece is held in fixture by cam lock seen in foreground.

CONTROLS SPEED

—NC unit replaces lathe handwheels

By Robert E. McKee
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R. K. LeBlond Machine Tool Co.
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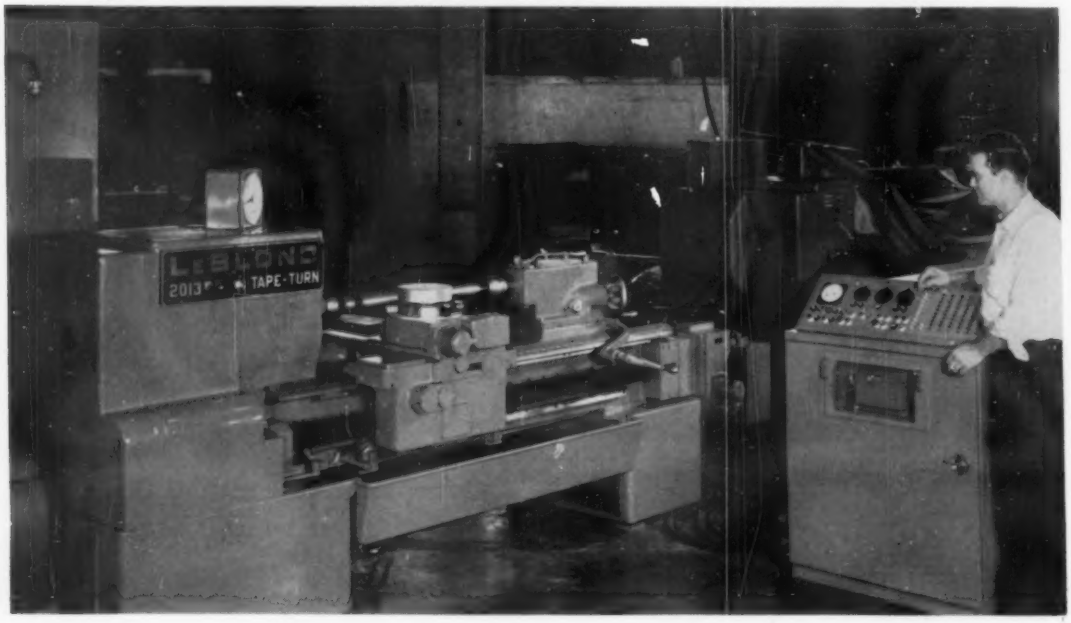
Removal of hesitation and uncertainty from the control of lathe operations can increase efficiency and reduce the production cycle by as much as 87 percent. The system discussed in this article accepts both operator and tape commands readily.

MULTIMOTOR DRIVES for machines replaced overhead belt drives many years ago because they offered more flexibility in plant layout and closer control over the immediate machining operations. Clutches, gears, limit switches, and actuators added to machine capability. In addition, numerical control now gives machine tools even greater capability.

Exemplifying these changes is the lathe, shown in *Fig.* 1. There are no gear shift or clutch levers on the headstock, no apron length feed handwheel, no crossfeed handwheel, no feed clutch or half-nut levers. The turret, *Fig.* 2, has six tool stations that can be indexed to any of five different positions for various turning, facing and boring cuts without using hand controls. These motions are controlled at the console shown in *Fig.* 3. Operator commands to

Fig. 1. Conventional controls, such as handwheels and levers are unnecessary on this lathe.



TURNING
and levers

the machine tool are made with the various dials and pushbuttons that signal the GE Mark Century numerical control unit controlling the lathe. In effect, the control unit's calculating ability can be used to assist in setting up the machine and in making necessary adjustments during operation of the machine.

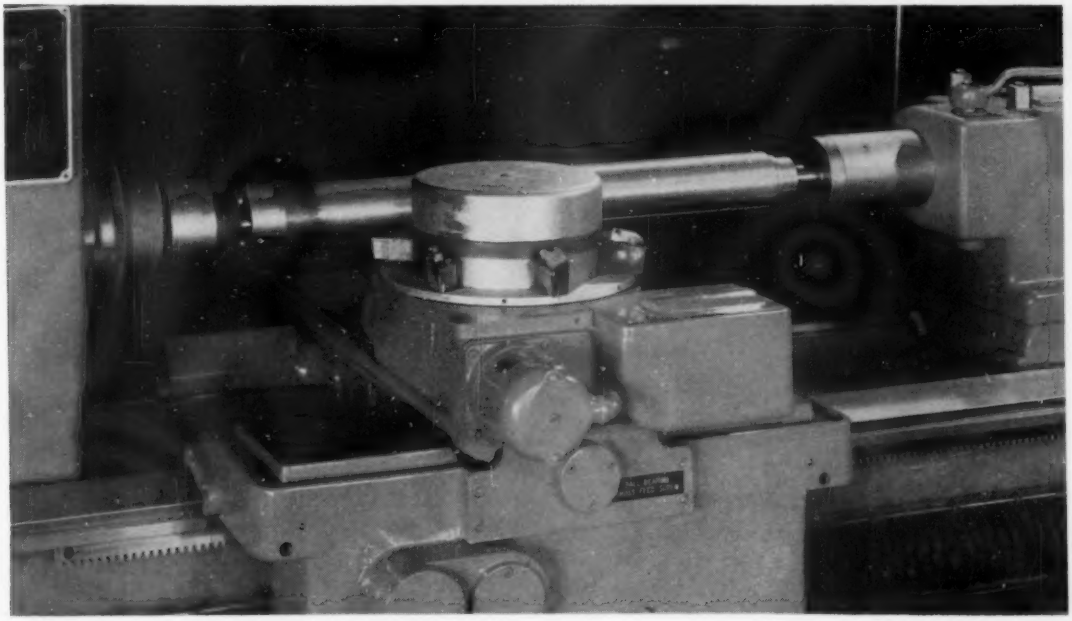
Without using conventional controls, the operator works from the pushbutton panel on the console to select turret tool positions and spindle speeds. He can set up precise taper cuts, straight-line cuts, radius cuts or threaded profiles. Whether the operator or the tape reader should be the source of commands depends on the complexity of the workpiece and the length of the production run. In either case, some preliminary calculations are required and the commands to the machine tool must be expressed in a language that can be understood by the control unit itself.

Command Language: The workpiece profile shown in *Fig.* 4 has been divided into appropriate sections suitable for programming although the actual machining is done in one continuous path. The three-section cut requires three sets of instructions in language understandable by the control unit. For the first of the sections, the taper cut with the tool moving toward Point 2, Code P1 establishes the mode of operation for the control unit. Movement commands will cause straight-line slopes to be generated. The geometry defining the length and angle of slope is given in the next four "words" of the command as shown in the tabulation in *Fig.* 4. Length of cut and direction of cut is indicated by the two words for X and Y movements. Angle of the slope is indicated by the words for the sine and cosine of the angle θ.

The balance of the command concerns not the geometry of the cut, but the machining conditions to be used. The feed word, F 0034, is given in ipm and is obtained, in this instance, by multiplying 340 rpm by 0.010 ipr, resulting in 34 units of 0.1 ipm. The designation for speed, S 32, causes the spindle to rotate at 340 rpm and is selected from a code-rpm chart. The T1 command provides the tool located in the first turret position for turning this workpiece.

For the second section of the path, going to Point 3, the mode is indicated by P2 and requires that the control unit generate a counterclockwise arc, as

Fig. 2. Turret carrying six tools can be indexed to any of five positions without using hand controls.



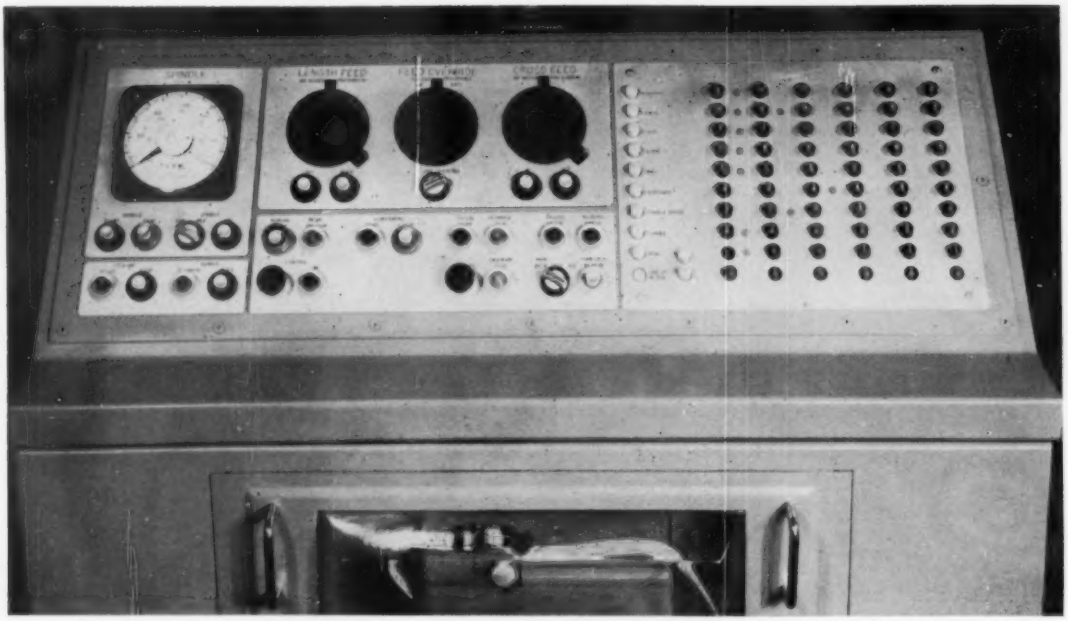


Fig. 3. Extensive control of the lathe and NC unit is given to the operator by pushbuttons and dials.

though the 3-inch radius on the workpiece were swung with a compass from Point 2 to Point 3. To swing the radius, the control unit needs to know the radius center location. This information is substituted for the usual sine and cosine words. In this example, the sine and cosine words indicate that the radius center is 2.7854 inches distant from Point 2 along the Y axis and 1.1141 inches distant along the X axis. The feed command of 11.2 ipm is found by using the expression $F = 3.4\ (10/R)$, and the other commands are unchanged from the previous block.

The final straight-line section of cut is straightforward. Since the slope of the cut is zero, θ is zero, and the cosine is 1. The sine is zero and is indicated by leaving a blank after the prefix L. This is a convenient ability of the control unit—it understands

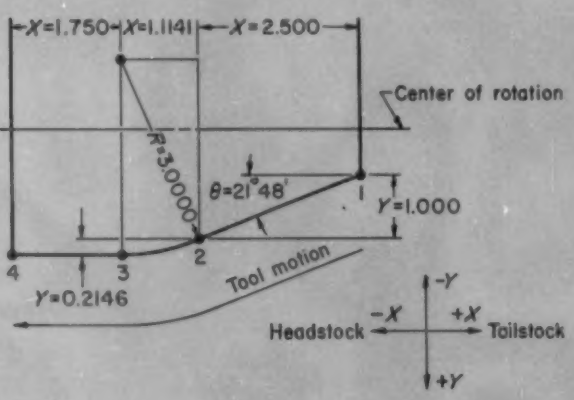


Fig. 4. Three blocks of instructions are required to generate a smooth continuous cutting path from Point 1 to Point 4. The instructions can be inserted by pushbuttons or tape.

Mode	X	Y	Cosine	Sine	Feed	Speed	Turret
P1	X-25	Y+1	K092848	L037137	F0034	S32	T1
P2	X-11141	Y+02146	K027854	L011141	F0112	S32	T1
P1	X-175	Y+	K1	L	F0034	S32	T1

blanks to be zeros, which saves having to enter zeros into the system. This ability was utilized in entering the zero command for the distance of *Y* axis travel.

Whether commands are entered using tape or pushbuttons, each block of instructions is composed in the same manner. The mode, dimensional data and machining instructions are supplied. The dimensional data concerns either straight lines or arcs (indicated by the mode instruction). The four words describing a cut (*X*, *Y*, cosine, sine) are based on straightedge-and-compass geometry and are thus similar to the methods used in making shop drawings, making the words fairly easy to handle and consistent with the language used by tool and manufacturing engineers in their daily work.

Tape Programming: For more complex workpieces, careful planning and analysis are required prior to listing blocks of instructions. A drawing, such as shown in *Fig.* 4, aids in visualizing workpiece geometry and the sequence of cuts to be made. Working from such a drawing, a program (the list of instruction blocks) is written out step by step. The completed program for the workpiece of *Fig.* 4 is shown in *Fig.* 5. The instructions actually necessary for machining the workpiece lie to the right of the double vertical line. Columns to the left of the double vertical line are program planner notes, to assist in analyzing the machining sequence. Several

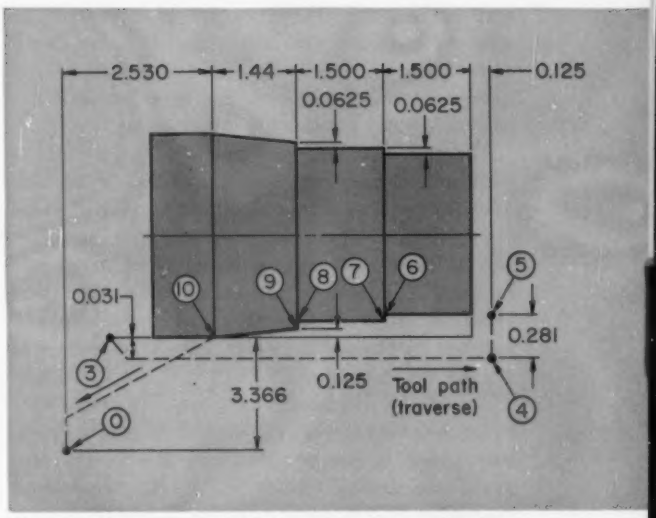


Fig. 5. Program analysis for a typical workpiece, made before the actual tape program is written.

of the instructions (denoted by P4) are time-delay instructions, to allow mechanical elements of the machine (clutches, relays and so forth) sufficient time to operate before the next instruction is delivered.

The first eight lines of the program are block instructions for a roughing cut that ends at Point 3

Fig. 6. To completely machine the workpiece, shown in *Fig.* 5, these twenty-one lines of instructions are sufficient.

LEBLOND TAPE TURN

PROGRAM EXAMPLE PROGRAM NO. 1 PART DATE

DRAWING NO. F-4450 MACHINE NO. PAGE 1 OF 1

STARTING POSITION: X-DIRECTION 1.47 TOWARDS HEADSTOCK FROM END OF WORKPIECE TO CENTER OF TOOL CURVATURE. TOOL NO. 1

Y-DIRECTION 5.177 FROM CENTER OF TOOL CURVATURE TO ℄ OF MACH. TOOL # 1

INITIAL DATA: TOOL OFFSET T1= 1/32 T2= T3= T4= T5= T6= MATERIAL

CUTTING SPEED RGH. 355 SFPM. FIN. — SFPM. FEED RGH. 010 IPR. FIN. — IPR. PROGRAMMER.

LAB	DWG PTS	REM'KS	ABS. X(+)	ABS. Y(−)	TYPE	DEPARTURES X ± X AXIS	DEPARTURES Y ± Y AXIS	SLOPE FUNCTIONS COS OF ∠	SLOPE FUNCTIONS SINE OF ∠	FEED IPM	SPIN SP'DS	TOOL	MISC. FUNCTIONS
1	0	START			P4	X0250				F14	S2	T1	M+3
2	1	TX	7.095	0	P1	X+70950	Y	K1	L		S32		
3	2	TY	7.095	3.366	P1	X	Y−33660	K	L1				
4		D			P4	X0001							
5		D			P4	X001							M−3
6	3	FX	1.345	3.366	P1	X−5750	Y	K1	L	F0034			
7		D			P4	X0001							
8		D			P4	X02				F14			M+3
9	4	TC	7.095	3.335	P1	X+5750	Y+00310	K1	L1				
10	5	TY	7.095	3.616	P1	X	Y−02810	K	L1				
11		D			P4	X0001							
12		D			P4	X001				F004	S33		M−3
13	6	FX	5.47	3.616	P1	X−16250	Y	K1	L				
14	7	FY	5.47	3.5535	P1	X	Y+00625	K	L1				
15	8	FX	3.97	3.5535	P1	X−15	Y	K1	L				
16	9	FY	3.97	3.491	P1	X	Y+00625	K	L1				
17	10	FT	2.53	3.366	P1	X−1440	Y+01250	K0996250	L0086480				
18		D			P4	X0001					S3		
19		D			P4	X002				F14	S2		M+3
20	0	TC	0	0	P1	X−2530	Y+33660	K1	L1				
21		STOP			P4	X							MO

and leaves the workpiece a cylindrical shape. The step cut and taper cut instructions begin at line 9 of the program. In all, 21 block instructions are required for this workpiece. The very last line is a time delay and program stop instruction.

The part planner usually returns the tool to its starting place on each program. This sets the machine up for the next workpiece and also provides a means of checking programming accuracy. The sum of motions on each axis should equal zero. If the sum is not zero, some figure-handling error has occurred, either in calculating or transcribing and requires that the programmer recheck his entries to remove the inaccuracy.

To write a program usually requires from three to six minutes per line; to punch it on tape approximately one minute per line. For this 21-line program, engineering time is 63 to 126 minutes and clerical time is about 21 minutes. This time is relatively short compared to making a template drawing and fabricating a template for the job, as would be required in tooling for a tracer lathe.

Tape-Controlled Turning: Floor-to-floor time on this workpiece is less than six minutes under tape control; using a tracer controlled lathe, more than nine minutes are required. An over-all improvement is obtained also, since 45.98 minutes are required per piece in lots of six, using tape control, and 190.5 minutes are required using a tracer lathe. This is a 75.8 percent time reduction. Time consumed in turning operations is reduced from 74 to 87 percent of the time required on a standard toolroom engine lathe, according to comparison studies made of different parts.

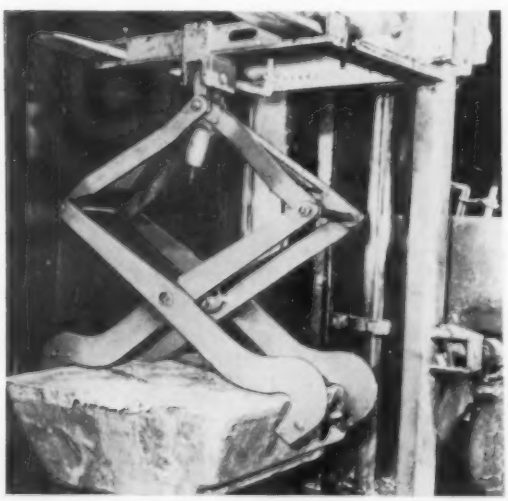
Some of the other advantages of numerically controlled turning machines indicate that this kind of equipment may considerably change the production of rotated workpieces. Lead time is reduced and the tapes are easily stored and easily rerun. Setup time is reduced, so that investment in parts inventory can be reduced.

Production experience to date also indicates that engineering costs, quality control costs and tooling costs are all favorably influenced by numerical control. It is the shortest and least expensive path from the designer's pencil point writing on paper to the completed workpiece.

From Paper 359, "Continuous Path Turning on Numerically Controlled Lathes," presented at the 1961 ASTME Engineering Conference. Copies of the complete paper may be purchased from Society Headquarters.

Automatic Tongs Handle Hoist Job

Use of automatic tongs, carried on a fork lift truck, has solved a materials handling problem for the Cupples Products Co. Div., Aluminum Co. of America. As a step in its manufacturing process, the Cupples plant, in St. Louis, Mo., must pick up aluminum sows, or blocks, in an open yard, carry them into the shop and gently deposit them in a furnace charging box. No overhead crane or hoist equipment is available in the yard.



After studying the problem, engineers of the Happenstall Co. designed a pair of 370-lb tongs with an upper framework that engages in the tines of a fork lift truck. The bottom levers of the tongs fit around the sow, holding it firmly and safely while lifting it. Quickly attached or removed, the tongs do not interfere with the use of the trucks for other lifting.

When a sow is to be moved, the operator maneuvers his truck so that its tines enter openings in the upper beam which supports the tongs. Driving the truck into the yard, he positions the tongs over the sow and lowers the tines. With their arms latched open, the tongs—clearing the sides—are lowered until they rest on the sow. This actuates the automatic mechanism which in turn unlatches the arms. When the tongs are raised again, the arms push against the sides of the sow and hold it firmly.

Reaching the furnace, the fork lift truck operator raises the tines, positions the sow above the charging box and lowers it to the floor of the box. The arms of the tongs push open and are latched by the automatic mechanism. The tongs, opening to a maximum of 38 inches, are capable of lifting 1100-lb loads. Heppenstall engineers say automatic tongs for use with fork lift trucks can be designed for various applications.

revolution in MANUFACTURING

Part 2—The Plant of the Future

By T. W. Black
Senior Associate Editor

Within 25 years, machines, tools, manufacturing processes and controls will be radically different from those found in today's plants. Despite the fact that much of his routine work will be performed by computers, tomorrow's tool and manufacturing engineer will play an even more important role in industry than he does today.

WITHIN THE NEXT 25 YEARS, there will be a revolution in manufacturing. New methods, new processes, new machines and new concepts of control will gradually supplant existing techniques. The result will be enormously increased productivity and efficiency—increases that should raise the American standard of living to levels that are undreamed of today.

Revolutions do not happen overnight. The seeds of the new Industrial Revolution are already planted and tomorrow's technology will be based, in large measure, on developments whose outlines can already be foreseen. The raw material of manufacturing progress is already in our hands and, under the hammer blows of competition, domestic and foreign, it is beginning to take shape.

Whether tomorrow's plant is built 10 years from now or 25 years from now depends mostly on our ability to assimilate technological developments and put them to work at a fast rate. The real barriers to real advances are psychological. We must learn to forget traditional ways of doing things, abandon time-honored habits of thought and be prepared to take up new philosophies of manufacturing. Innovation requires new attitudes.

Assuming that these new attitudes are adopted by industry, the manufacturing plant of the future can already be tentatively sketched and its foundations may be laid long before 1975.

Plant Design and Location

The plant of the future will be of one-story construction and may even be underground. One-floor construction makes good sense from the standpoints of manufacturing efficiency and economics. There is a growing trend today toward tighter manufacturing tolerances. This trend is apparent not only in the aircraft and missile industries and the instrument industries, industries that usually require close tolerances, but also in the manufacture of consumer products such as automobiles. Maintaining these close tolerances calls for close control of temperature in manufacturing, assembly and inspection areas. Close control of humidity and dust is also necessary and it can be expected that these controls will be even more important in the plant of the future. Environmental control can best be maintained in a one-floor plant. Such a plant could well be underground—either in a natural or man-made cave or in what would amount to a windowless, roofed-over basement. The one-floor plant also has advantages in easier material handling, greater floor load capacity and lower construction costs.

A high degree of automation will keep manpower requirements at minimum levels on the production floor in the plant of the future. This will mean that less space will be required for the usual employee

facilities such as cafeterias and washrooms. Much of the material handling will be performed by conveyors, and raw stocks, parts and assemblies will probably be stored in floor-to-ceiling racks that are loaded and emptied automatically, using punched-card or pushbutton controls. Wheeled, manned material handling equipment will probably be a thing of the past in most plants, which will cut down on aisle space requirements. Storage space requirements will be small because manufacturing lines will be more versatile, thus be capable of turning out relatively small lots of parts economically.

What all of this means is that in the plant of the future, productive floor space—space occupied by machines and equipment that actually turns out parts and assemblies—will take up a much higher percentage of the plant's total area than is the case today. Because of this, and because of the more highly productive methods, processes and equipment that will be in use, over-all plant productivity per square foot will be at extremely high levels, as will worker productivity.

Treatment of industrial wastes will be relatively more important in the plant of the future than it is today. More and more communities are requiring the use of smoke precipitators and other devices to minimize the contamination of the atmosphere by combustion products or industrial fumes. Similarly, treatment of water to remove or de-activate various undesirable waste products of industrial operations before they enter sewers or streams is becoming a necessity already and will almost certainly be mandatory in most communities within a few years. From a conservation point of view, the reclamation of these wastes is desirable already and, in the long run, waste reclamation will doubtless pay for itself, particularly in the light of advances in chemistry that are already making the reclamation of many materials economically feasible.

During recent years plants have tended to move to the suburbs close to large cities, where sufficient land to permit modern one-story construction is to be found. Large plants have been located close to large population centers simply to insure an adequate supply of workers. In the automated plant of the future, fewer workers will be required and location close to population centers may no longer be necessary. Already many plants are being built away from the usual industrial centers in order to take advantage of favorable local conditions so far as taxes and climate are concerned. This trend will continue during the foreseeable future. With the advent of fast truck transportation, better rail service and lower-cost air freight, being physically close to markets will tend to lose some of its importance. Fast information-gathering and processing techniques, to be discussed later in this article, will make it possible for individual companies to locate their operations in different parts of the country without a loss of close control and coordination by a centralized management.

Plant locations will still, of course, be governed to a large extent by the availability of electrical power and water. Advances in nuclear power may ultimately lead to the establishment of nuclear power-generating stations in areas that are far from supplies of coal, oil, natural gas or water power. This will permit wider geographical distribution of industry. Similarly, the development of devices for the more efficient conversion of solar energy to electricity may have a major impact on plant locations, enabling plants to produce all of the electrical power needed for their own operations with their own facilities.

Role of the Computer

During the first Industrial Revolution, water power and steam power were introduced as a substitute for human effort in the factory. Many experts believe that the second Industrial Revolution started with the advent of fully mechanized materials handling, including machine loading and unloading. Actually, however, this is only a logical outgrowth of the first Industrial Revolution. The second Industrial Revolution really started when the concept of automatic control of metalworking processes was introduced.

Mechanization freed the machine operator from heavy manual effort; automatic control frees him from the need to continuously manipulate levers and switches. The result is faster machine operation and, often, more uniform product quality.

With the introduction of computers, the scope of automatic control has been greatly extended. In some cases, products are designed on a computer, then a machining tape is automatically turned out on the same computer, materially cutting the time lag between product design and fabrication of the product in metal. Even more important, the use of computers in manufacturing has freed engineers from tedious routine computations and given them more time for creative work. Further advances in computer technology make it inevitable that computers will be used throughout the plant of the future.

The development and application of computers to perform jobs that previously required human mental effort have been accompanied by an equally important but sometimes little-recognized development—greatly improved instrumentation that can take the place of the human senses. Ultrasonic and magnetic crack detectors, infrared analyzers of all kinds, electronic gages that amplify and record sizes and finishes within tolerances of millionths of an inch are only a few of these. This instrumentation, coupled with the ability of the computer to make decisions on the basis of input data almost instantane-

ously, makes fully automatic control of manufacturing operations possible and this control will be an important feature of the plant of the future.

Not all of the computers used in the plant of the future will be of large size. Small, simple computers, designed for specific purposes will be developed. These computers will become a part of the machine. An example is a computer used with a numerically controlled machine to detect variations in work material hardness or thickness. Such a computer, which is already a reality, can override taped instructions to permit the job at hand to be performed more efficiently. Similarly, a computer can be used to detect variations in part size and make necessary machine corrections. Devices of this kind, incorporating only a few logic elements, will become commonplace in the plant of the future. They are, incidentally, already available today for many types of manufacturing operations.

Somewhat larger computers will be used to control entire manufacturing lines, regulating the flow of parts and materials and monitoring quality and output. There are computers in existence today that can do just this and as their potential is recognized, they will gradually be installed in large manufacturing plants. With their ability to process and record large amounts of data, as well as to control production lines, these computers will be an important management tool. Reports on production, inventories and similar matters can be produced by a computer in seconds when that computer is linked to stations in the manufacturing area. Thus management will have literally up-to-the-minute information whenever it is needed for decision making.

Already some plants are using computers to simulate production lines. A mathematical model of a line is established and this model is transmitted to a computer. Mathematical "parts" are then run through the line by means of a computer program. The equivalent of several years' actual production operation can be simulated on a computer in just a few minutes. There will be more of this computer simulation in the future for manufacturing planning, because this technique enables the bugs to be worked out of proposed lines before the actual line is built.

Computers will also be used, on a routine basis, to determine the most efficient machine loading, optimum size of inventories and the like. Today, this type of planning is performed with pencil and desk calculator in most plants—a time-consuming, tedious and sometimes inaccurate procedure.

Another use of computers in the plant of the future will be in product design. The output of a computer that designs a product can be a tape that controls a machine tool or even an assembly line. Successful applications of computers for product design have already been made and there is no reason why this technique should not become fairly commonplace in the plant of the future.

Computers will also be used to determine the performance of new products before they are actually built, applying simulation techniques. Computer simulation may be used to determine the impact of planned products on manufacturing facilities and to develop cost estimates for alternative designs as well.

Even when parts are designed with pencil and paper, the usual drawing will probably look considerably different from the drawings in use today. Drawings for parts that are to be produced under numerical control will probably be more concerned with cutter paths and coordinates—the type of information that is used in programming a numerically controlled machine tool—than with depicting actual part configurations and the usual dimensions.

Machine Design

Machine tools in the plant of the future will probably bear only superficial resemblance to the machines in today's plants. With wide application of automatic controls, particularly numerical controls, there will be little need for operators to closely monitor all aspects of production. Today most machines are designed to a large extent for operator convenience. The new generation of machine tools will be designed for fully automatic operation, which may result in radically different machine configurations.

Undoubtedly, computer simulation will help to develop this new type of machine tool. The effects of different designs can be evaluated in a hurry with computer simulation and many of the calculations required for good design can be expedited with a computer. While new designs of machine tools will be tested adequately, of course, it is probable that much of the lengthy testing that is required today when a new machine is being developed will not be needed when computers are used to check out new design concepts.

The distinction between various machine types will probably fade away during the next couple of decades. With the advent of numerical control, machines called "machining centers" and capable of performing milling, boring, drilling and other operations have come into existence. When equipped with automatic tool changers, these machining centers exhibit a high degree of versatility. Often 20 or 30 individual machining operations can be performed in one setup automatically. This concept of machining is a genuine breakthrough that portends great future advances in machining efficiency. A small plant with one or more of these versatile machines can be as productive as a larger plant with many standard machines; perhaps the plant of the future will be smaller than the plant of today.

Manufacturing Processes

There are many ways to shape metals. Machining—metal-removal—is only one of these ways and, in the long run, it may lose its present dominant position. In the plant of the future, many of the machining processes will undoubtedly be replaced by precision forging and casting, cold extrusion, powder metallurgy techniques and the like. The reasons for this change will be the desirability of making parts in as few operations as possible—an ideal that is not always realized today. This change will be accelerated by the ease with which precision dies and molds can be produced under numerical control, and also by the improvement of electrical and ultrasonic processes for die sinking.

Explosive and other high-energy forming methods will be common in the plant of the future. Again, the desirability of shaping parts in as few operations as possible will furnish a strong impetus to the adoption of these methods. Massive presses may be a thing of the past in 1975 for most forming. Here, too, the long-range trend favors the smaller plant because with high-energy forming, the small plant can compete with the larger plant without a large investment in heavy equipment.

Advances in servomechanisms foreshadow the wide use of automatic assembly in the plant of the future, even for many operations that now require skilled hand labor. Assembly machines, like metalcutting machines, could be programmed by tape and could be made highly versatile, able to perform assembly of many different products with a change of tools and control tapes. The development of assembly centers, similar to the tape-controlled machining centers that are now in use, is not out of the question; indeed machines of this kind could be built today.

Doubtless many new processes will be developed during the next several decades. Their specific natures cannot be predicted here. However, they will: (1) utilize high energies to obtain faster metal-shaping speeds; (2) be adaptable to automation; (3) be capable of high versatility; and (4) utilize compact equipment. All new processes must fill these requirements to be widely applied in the highly productive, yet compact, plant of the future.

Manning the Plant of the Future

The highly automated and mechanized plant of the future will require fewer production workers per unit of output than today's plant. There will be a higher proportion of setup and maintenance personnel, who will have a much higher degree of training and skill than is normally the case today. And a broader range of specialized skills—electronics, hydraulics, electrical—will be required. With a heavy investment in automated equipment, downtime will be costly, and emphasis will be placed on getting idle machines back into production in a hurry.

The broad role of the tool and manufacturing engineer as the man who plans production lines will remain unchanged, but here, too, the emphasis will be on a higher degree of knowledge and skill. The bread-and-butter items of tool engineering—tool design, fixture design and so on—will remain, but, in view of the extensive use of automatic machines and automation, somewhat greater ingenuity will be needed in these fields.

Because of the broader range of manufacturing processes available—many of them complex—tool and manufacturing engineers will have to have a broader knowledge of the field of manufacturing than they have today and, due to the more rapid advance of technology in future years, they will have to continuously study in order to keep up to date.

The importance of basic and applied research will be widely recognized and it is probable that a much higher percentage of tool and manufacturing engineers will be engaged in research than is the case today. A solid academic background, with emphasis on mathematics and manufacturing science will be mandatory.

For, in the long run, the success of the plant of the future depends on the tool and manufacturing engineers of the future. Educated engineers, rather than bricks, mortar and metal, are the real resources for manufacturing progress.

Incidentally, ASTME recently proposed to the National Science Foundation that the field of manufacturing be surveyed to define present-day and future educational needs in this field.

Tomorrow's Management

Management control of all aspects of production will be somewhat better in the plant of the future than it is today. Computers and automatic data-processing equipment will make a wealth of information immediately available to management and this information will be invaluable in making sound decisions. Also, computers will compare possible courses of action, simplifying decision-making.

This should make it possible for top company management to devote more time and attention to engineering matters—product design and development, research, manufacturing. In short, management will become more engineering minded.

Because of the greater complexity of many products and the greater diversity of manufacturing processes, it can be expected that more and more manufacturing engineers will enter top management. These engineers will tend to encourage technical innovation—an attitude that will be the strongest impetus to real progress in manufacturing.

how to improve TRACER LATHE ACCURACY

Part 3—Slides Check

By J. Bryan, J. Bowerbank, E. Holland, O. Mohl
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University of California
Livermore, Calif.

Space-Age requirements for greater tracer lathe accuracy can be met when the sources of lathe error are individually pinpointed and corrected. A six-step checking method developed by University of California engineers provide extensive data on the sources and extent of part and machine errors.

STRINGENT REQUIREMENTS for component accuracy are commonplace in the aircraft and missile industries. Often these requirements cannot be met with existing machine tools. When the sources of machine error are isolated, however, it may be possible to correct them individually. The result is greatly improved machine accuracy. This article describes methods of locating and determining quantitatively the errors of tracer lathe machining. Part 1, appearing in the April issue, covers a check that enables composite nonmachine errors to be detected. Part 2, appearing in the May issue, covers four checks that provide data on lathe operating error—the twin disk check, the single disk check, the spindle check and the template carrier check. This part of the article covers a method for determining lathe slide accuracy.

The slides check measures how accurately the slides function to maintain rectilinear motion—the extent to which a slide maintains its angular orientation as it moves along its travel. The consistency of angular orientation can be determined by measuring the angular displacement of a slide in three coordinates—pitch, yaw and roll—as the slide moves. This is shown in *Fig.* 1.

In the tracer lathe slides check, the angular displacement in pitch, yaw, and roll of each machine slide, is measured against the orientation of the slide at the beginning of travel. Any suitably accurate angular measuring device can be used to make the slides check. For most lathes, however, the only suitably accurate device is the autocollimator, which is used with a reflecting mirror. The reflecting mirror is placed on the slide whose angular movements are to be measured. The autocollimator is aligned to view the reflection of its light source from the mirror. *Fig.* 2 shows this arrangement. Any angular movement of the slide will change the angle of the reflected light rays as they enter the autocollimator. The autocollimator measures the change in the angle of the entering light rays if the change is in the sensitive plane. This means the autocollimator cannot measure pitch and yaw at the same time but must have its sensitive plane adjusted to read the desired angular movement. The distance between the reflecting mirror and the autocollimator does not change the reading. The reading varies only as a function of changes in the angle of the light rays entering the lens system. The autocollimator is able to measure small angular changes accurately because a very small change in the angle of the entering light rays will produce an easily discernible shift in the position at which the light rays are focused.

The autocollimator is ideal for measuring the pitch and yaw of a slide system. To measure roll with an autocollimator, it is necessary to have an optical flat to use as a reflector that is as long as the travel of the slide to be measured. This is be-

cause the slide will be moving across the line of sight while measuring roll. If a long optical flat is not available, a precision level may be used to measure roll.

The readings of a slide check should be taken at fairly frequent intervals, about every ⅛ inch of travel. A glance at the resulting set of readings will tell how straight the slide is in the coordinate measured. But whether or not a slide has a significant error depends on what the other slides are doing. Sometimes errors in slides will compensate one another so that the errors cancel and do not show in the twin disk check. Conversely, a group of small slide errors may be additive and result in a large twin disk check error.

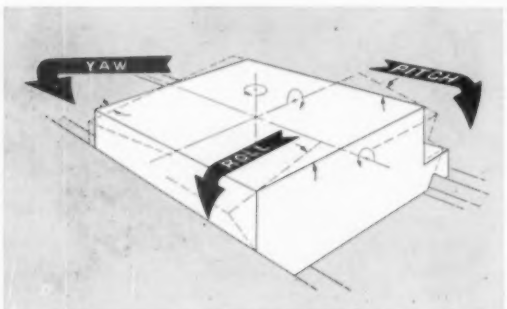


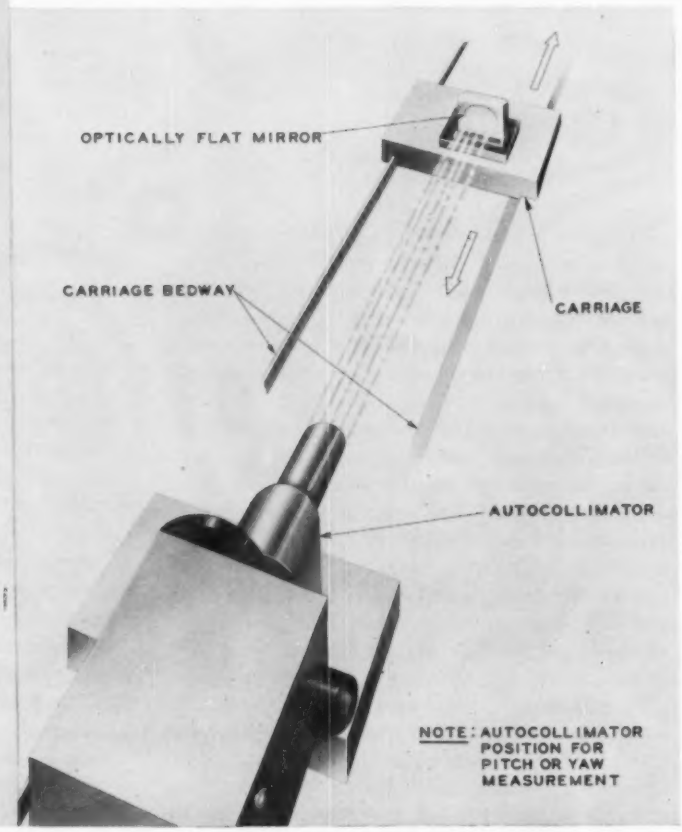
Fig. 1. (above) Pitch, yaw and roll motion of a slide. These angular displacements are measured in the slides check to determine how accurately the slide maintains its angular orientation as it travels.

Fig. 2. (right) Schematic drawing of slide check. An angular movement of the slide changes the angle of the reflected light rays.

To determine the significance of slide errors it is necessary to correlate the slide check results with the twin disk check results. In doing this, the slide results should be marked so that each reading corresponds to a point on the twin disk check results. This can be done by running a correlation check with twin disk templates, marking the twin disk check results at each slide check reading. Another way is to mark the slides during a twin disk check and use these marks later during the slide check to correlate the results.

The purpose of the analysis of the slide check results is to determine the composite effect of each slide's error at each point of reading. If there is no other error, the composite slide error at a particular point will be close to the twin disk check reading at that point. Whether or not a slide eror is significant also depends on the location of the template with respect to the part being worked. The significance of pitch errors of slides varies with the difference in height of the template and the cut. A rule of thumb is that a pitch error will displace a tool 0.000005 inch per second of pitch times the number of inches in height between template and cut. If a template is at the same height as the cut, the pitch error becomes second order and is negligible.

Fig. 3 illustrates the effect of template and cut



displacement in height on pitch error. Errors in roll are determined the same way by the difference in height of template and cut. The same formula applies to a yaw error except that the critical distance is the horizontal displacement between stylus and tool.

Another factor affecting the significance of slide errors is whether or not the error movement is normal to the cut or at some angle to it. In the case of a half disk template, bedway pitch errors occurring at the pole of the template cause machining errors that are 100 percent of the resulting pitch error at the tool. A similar pitch error occurring at the equator is insignificant because the error movement is along the surface being cut instead of normal to it as it is at the pole. *Fig.* 4 illustrates this and shows that the significance of a slide error in pitch varies with the cosine of the angle between the direction of error movement at a point and the normal to the surface of the template at that point.

To determine the significance of slide yaw errors, the position of the template with respect to the cut in the horizontal plane must be known. The significance of yaw error varies with changes in the angle formed by the line between the point of cut and the point of template contact and the normal to the template surface at the point of contact. As shown in *Fig.* 5, if the template, work part, and heavy axis lie in a straight line, yaw errors for a half disk template will be negligible at the pole and have a one-to-one ratio with the resulting tool error movement at the equator. If the template were on the normal to the point of the cut at the equator, the yaw slide errors would be insignificant at the equator and fully effective at the pole.

Fig. 6 illustrates how the composite slides error is analyzed. In the example shown, the tool is at a point 30 deg from the twin disk check pole position. The yaw, pitch, and roll values are in seconds of arc. The results are listed as minus if a part being cut would be undersize for such an error. To assign the right sign, it is necessary to determine what direction of angular displacement is indicated by the autocollimator changes and to determine what movement such an angular displacement would cause at the tool compound. It is also necessary to know the position of the master template with respect to the work template to determine direction of tool error movement. Because the angles are so small, it is accurate enough to consider the tool error movement resulting from slide error as straight line movement rather than arcs.

Fig. 6 shows the direction of these error movements with respect to the tangent of the part contour at the 30 deg point. A close approximation of the effect at the tool compound of slide pitch and roll error can be made by multiplying the height difference in inches between master template and tool by the angular displacement in seconds, and by 0.000005, which will give the tool compound error movement in inches. The effect of yaw can be approximated similarly, except that the horizontal difference in inches between stylus and tool is used. In the example shown, the height difference for pitch and roll is 10 inches and the horizontal difference for yaw is 20 inches. For yaw error analysis, it is also necessary to know the orientation of the line between stylus and tool. In the example shown, the line is 45 deg from the bedway axis. This orientation is important in determining the effect of yaw errors at different points on the tem-

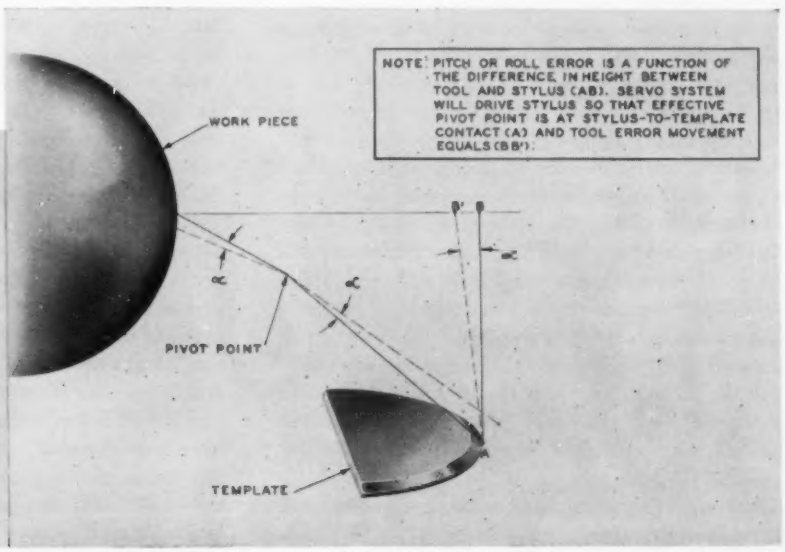


Fig. 3. Effect of template and cut displacement in height.

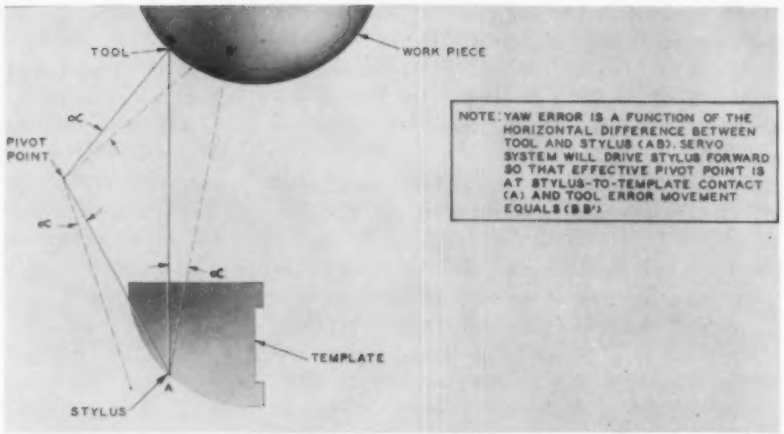


Fig. 4. (below) The significance of a slide error in pitch varies with the cosine of the angle betwen the direction of error movement at a point and the normal to the template surface at that point.

Fig. 5 (right) If the template, work part and bedway axis lie in a straight line, yaw errors for a half-disk template are small at the pole.

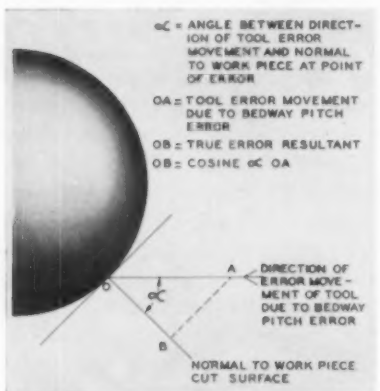


plate because it determines the direction of error movement. The effect of yaw errors is computed for a point 30 deg from pole position on the template in this example. *Fig.* 4 shows that, because of the zeroing effect of the servo system, the pivot point of a slide error can be considered as being at the point of servo transducer stylus to master template contact.

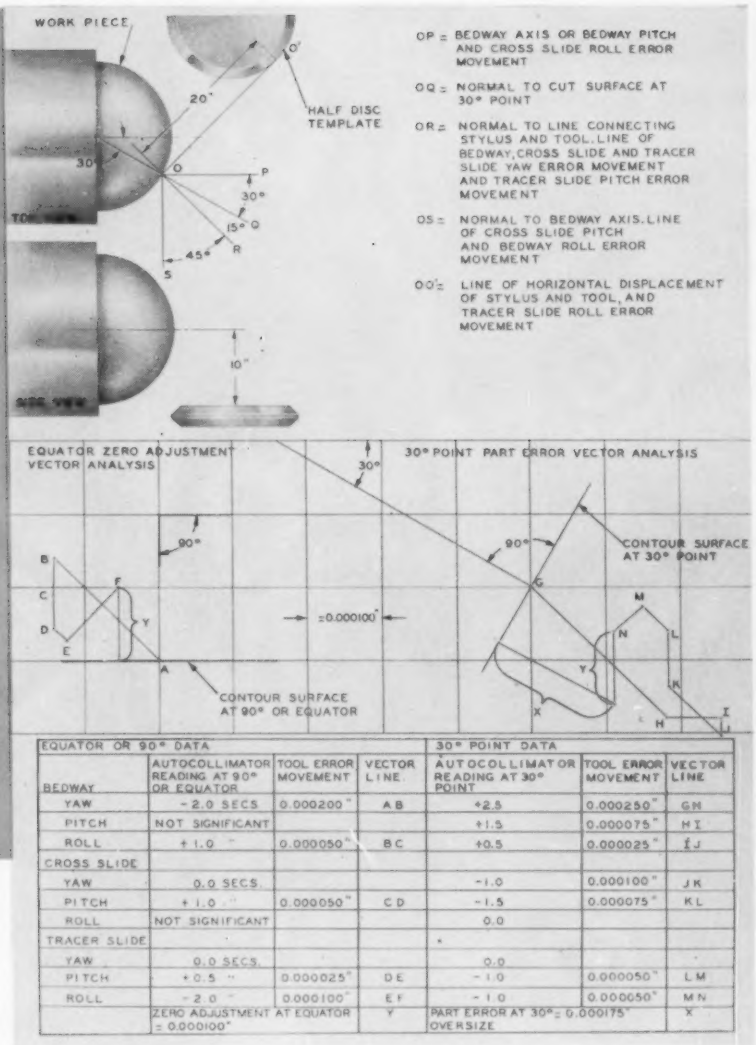
From the sketch in *Fig.* 6, it can be seen that yaw errors at the point of cut being analyzed will result in tool movement 15 deg from the normal to the template surface at the point of contact. In the example shown, the effect of the yaw error can be determined by multiplying the horizontal distance in inches between stylus and tool times 0.000005, and drawing a vector 15 deg from the part contour tangent representing this yaw error. In a similar way, the effect of the other slide errors for the 30 deg point can be determined. In each case, the tool compound movement in inches is drawn as a vector oriented with respect to the tangent to the part contour at the point of analysis. Contour curve may be ignored because of the small distances being considered.

The direction of movement of the tool compound is a function of the kind of error considered—pitch, yaw, or roll—and the orientation of the slide travel with respect to the template. This is why, in the example shown, the effect of a bedway yaw error is the same as a tracer slide pitch error. Each slide error will result in a tool error movement that is represented in *Fig.* 6 as a vector. To complete the slide error analysis, however, the effect of zeroing must be included. The autocollimator readings may be considered to start at either end. If, as in the example shown, the autocollimator readings are considered as beginning at the pole, the pole reading is defined as zero. The accumulated slides error at the equator is zeroed by the equator zero adjustment.

To determine this zero adjustment vector, the composite slide error at the equator must be determined. This is also done by vectors and, in the example shown, results in a zero adjustment of 0.000100 inch away from the part (vector *Y*). This zero adjustment vector is added to the vector analysis of any point analyzed, including the equator position, which, of course, it zeroes to no error. The analysis of the slide errors indicates that the composite slide error (vector *X*) will cause a part to be 0.000175 inch oversize at the 30 deg point.

If slide errors are the only significant errors in a lathe, plotting the composite effect of these errors for many points along the template bearing should produce an error curve that is similar to the twin disk check error curve.

A bedway yaw error could be caused by a curved vee. A vee with an "S" curve will result in plus and minus readings. Another source of bedway yaw error is vee bellmouthing. Bellmouthing can usually be detected by making autocollimator readings while the carriage movement is reversed by the hand wheel. Bedway pitch errors are caused by lack of straightness of both vee and flat. Leveling



EQUATOR OR 90° DATA				30° POINT DATA		
BEDWAY	AUTOCOLLIMATOR READING AT 90° OR EQUATOR	TOOL ERROR MOVEMENT	VECTOR LINE	AUTOCOLLIMATOR READING AT 30° POINT	TOOL ERROR MOVEMENT	VECTOR LINE
YAW	- 2.0 SECS.	0.000200"	AB	+2.5	0.000250"	GH
PITCH	NOT SIGNIFICANT			+1.5	0.000075"	HI
ROLL	+ 1.0 "	0.000050"	BC	+0.5	0.000025"	IJ
CROSS SLIDE						
YAW	0.0 SECS.			-1.0	0.000100"	JK
PITCH	+ 1.0 "	0.000050"	CD	-1.5	0.000075"	KL
ROLL	NOT SIGNIFICANT			0.0		
TRACER SLIDE						
YAW	0.0 SECS.			0.0		
PITCH	+ 0.5 "	0.000025"	DE	- 1.0	0.000050"	LM
ROLL	- 2.0 "	0.000100"	EF	- 1.0	0.000050"	MN
	ZERO ADJUSTMENT AT EQUATOR = 0.000100"		Y	PART ERROR AT 30° = 0.000175" OVERSIZE		X

Fig. 6. Method for analyzing composite slides error. Yaw, pitch and roll values are in seconds of arc.

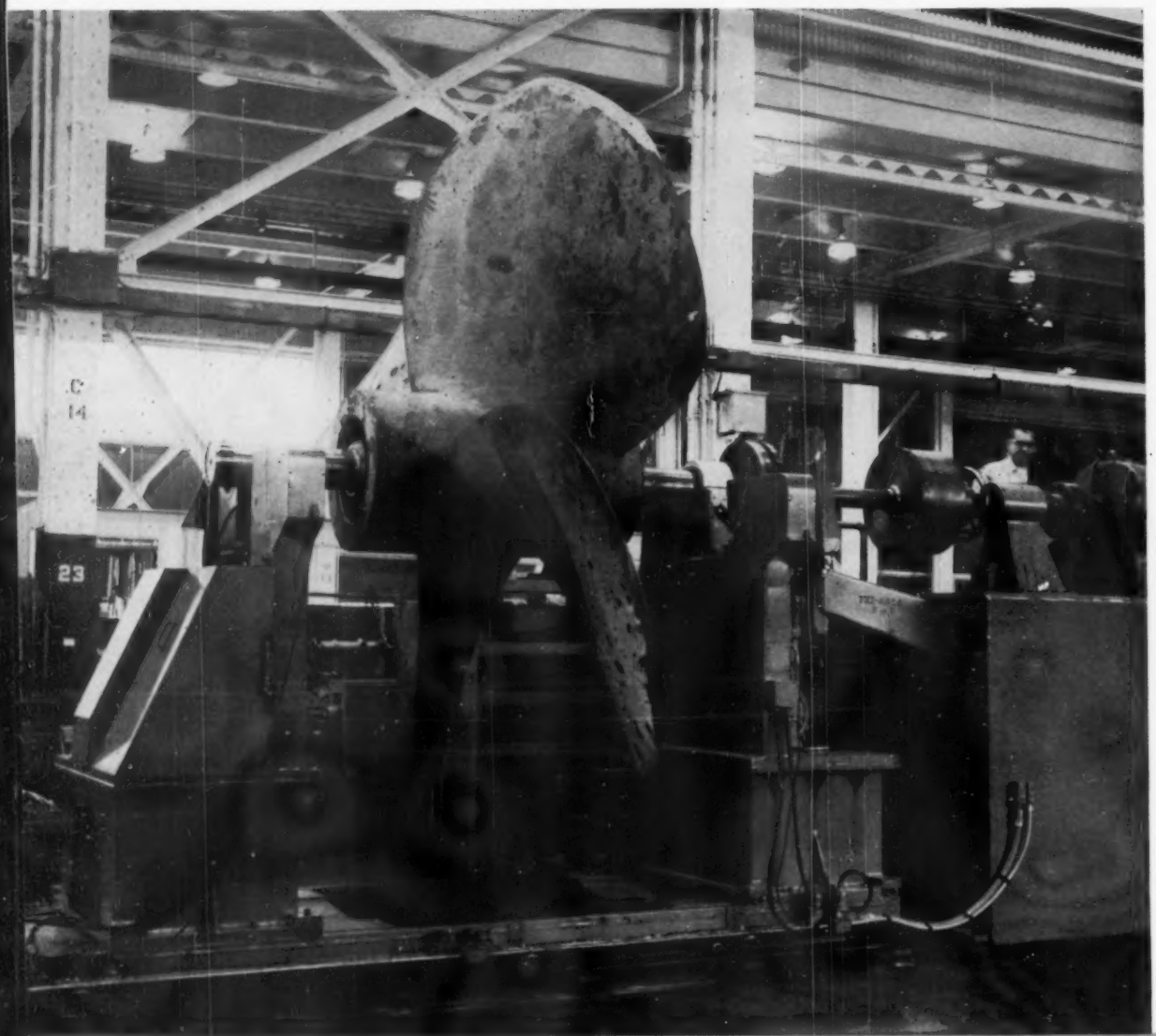
of the bedway can sometimes correct this. Bedway roll errors are caused by the vee and the flat not staying in the same plane. This too can often be corrected by adjustment of leveling screws. The best way to eliminate pitch and roll slide errors, however, is to bring the template to the level of the workpiece. Cross slides and tracer slides have the same error sources and remedies as bedways except that dovetails rather than vees are used to control yaw.

Excessive shake can also cause slide errors. Tightening the gibs reduces shake. Tightening the gibs, however, also increases the servo system load so that additional servo system stylus deflection is required. The gibs should be adjusted so that the error caused by shake and the error caused by stylus deflection are balanced at a minimum composite error. The fit of the slide wipers should be tight enough to clean the slide, but no tighter.

If it is necessary to rework a slide to improve straightness, it can be either ground or scraped. If the necessary jigs and precision grinders are available it is probably better to grind, but this is a matter of opinion. Grinding or scraping slides to improve straightness is largely a trial and error process in which experience is most helpful.

While the various checks described are time consuming, they make it possible to determine the significant sources of tracer lathe error with a high degree of accuracy. Once the errors are corrected, the performance of the lathe will be greatly improved. This makes the checks worthwhile.

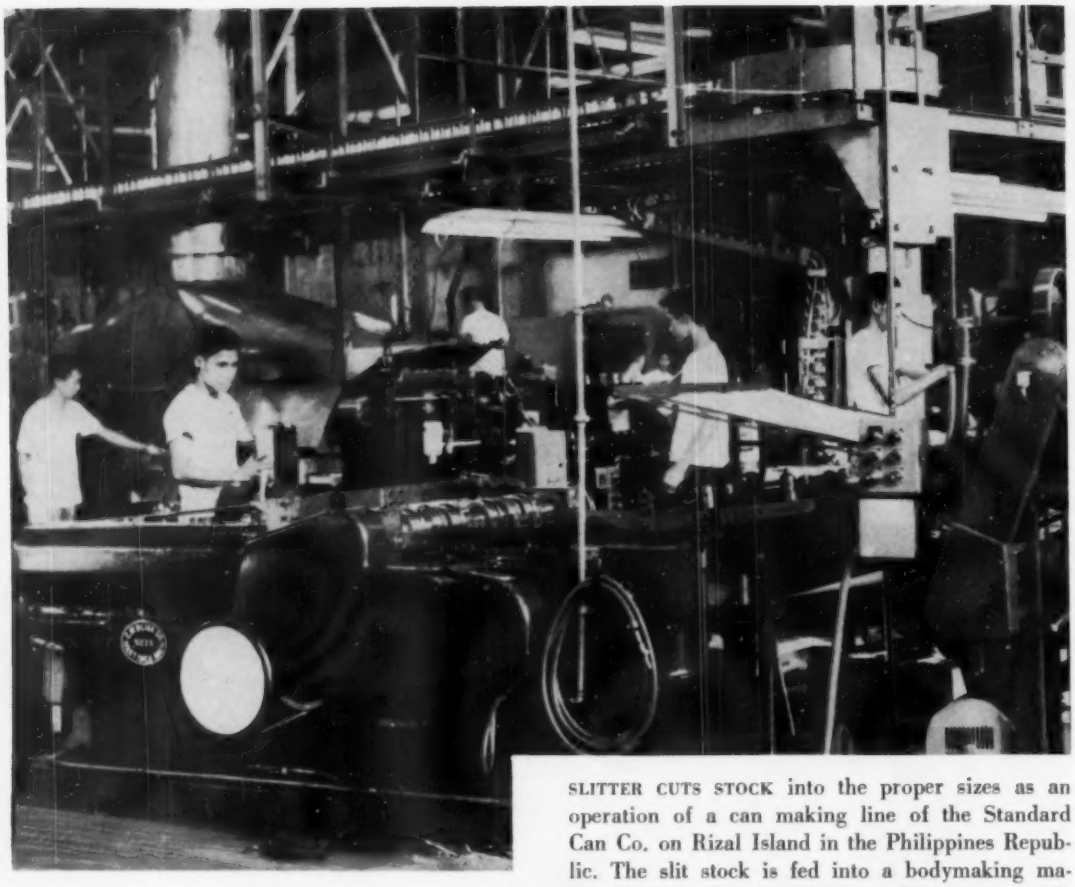
This article is based on Paper 362, "Upgrading Tracer Lathe Machine Operations," presented at the ASTME 1961 Engineering Conference. Copies of the complete paper, which includes a full description of the lathe check equipment used and details of the procedures followed, are available for purchase from Society headquarters.



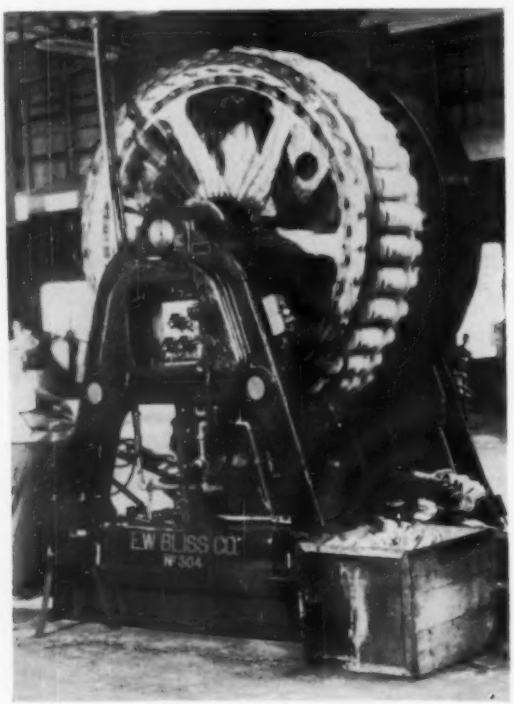
DESTROYER PROPELLER receives a single plane static unbalance correction at the Long Beach Naval Shipyard. This method is generally used when the diameter of the workpiece is considerably greater than the width. The work is held in half-bearings and rotated at 150 rpm. Electrical networks give accurate readings to locate unbalance, which is then corrected by grinding. Average floor-to-floor processing time is four hours, including crane handling and grinding. This Gisholt Type U Balancer replaces a previous method that required an average of 24 hours per workpiece and also required rotating the workpiece at dangerously high speeds.

TOOLS at work

VIBRATOR TRANSDUCER ASSEMBLY is removed from the bottom of a vacuum arc furnace to prepare for the pour of a 2000-pound stainless steel ingot at the Blairsville plant of Westinghouse Electric Corp. The ingots poured through the bottom of the furnace measure 60 inches long with a 12-inch diameter and after subsequent machining operations become rotors. The purpose of the transducer is to generate ultrasonic vibration that causes a small equiaxed structure in the ingot. This structure provides improved mechanical properties in the final workpiece.



SLITTER CUTS STOCK into the proper sizes as an operation of a can making line of the Standard Can Co. on Rizal Island in the Philippines Republic. The slit stock is fed into a bodymaking machine visible in the background. Approximately 350,000 cans are turned out daily and supplied to a dairy plant located close to the canning plant for economy in handling and transportation.



TOOLS at work

(Left) FINAL STEP before the 14-ounce cans go into storage is testing on this automatic can tester that rejects defective cans having the slightest leak. The canning machinery was made in the Hastings, Mich., plant of the E. W. Bliss Co. and shipped to Rizal Island for installation. By eliminating the need to import collapsed cans, economy in can production will result.

computers for MANUFACTURING

—automatic decision-making aids production

By A. H. Kuhnel
Division Manager
Austin Electronics
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Productivity can be sharply increased by using automatic decision-making and control devices as an integral part of production operations. The author explains how to apply computers advantageously to different production tasks.

SETTING UP production equipment to manufacture parts or assemblies usually requires that tool and manufacturing engineers arrange for two main functions: operation and control. The operations consist of metal removal, metal forming, joining, molding, or whatever process is required to physically produce the desired end product. Control of these operations is accomplished by the operator, fixturing, inspection, or other means. Because design engineers stress the physical aspects of the product (weight, dimension, strength and finish), the control aspect of production often receives only secondary consideration.

Considerable gains in production efficiency can be achieved by careful analysis of control needs and selection of appropriate computing and control devices. These devices sense what is occurring in the manufacturing process and then make a decision about it. The control can be as simple as a limit switch that senses the length of bar stock and "decides" to operate a cutoff saw, or more complex, like the computer shown in *Fig.* 1.

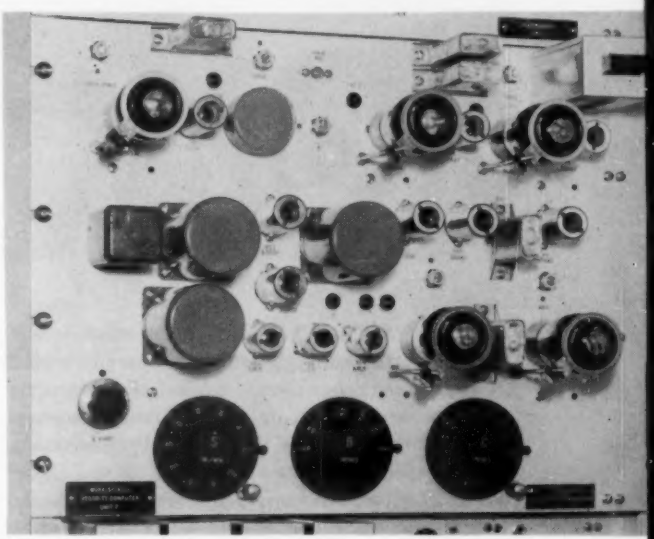

Fig. 1. Production tool that computes from six input variables to maintain a constant chip removal rate in milling turbine blades.

Computers That Control: With both computers and techniques for using them available, the decision making aspect of production equipment becomes more significant. In analyzing a production facility, it is now practical and feasible to specifically examine the decision making involved in the process and to use computer devices where they offer advantages.

For off-line manufacturing functions, general purpose computers are usually selected for economy and efficiency. An example of this is in the off-line preparation of tape for a numerically controlled machine. To be advantageous, the computer must prepare tapes for a variety of parts and the same

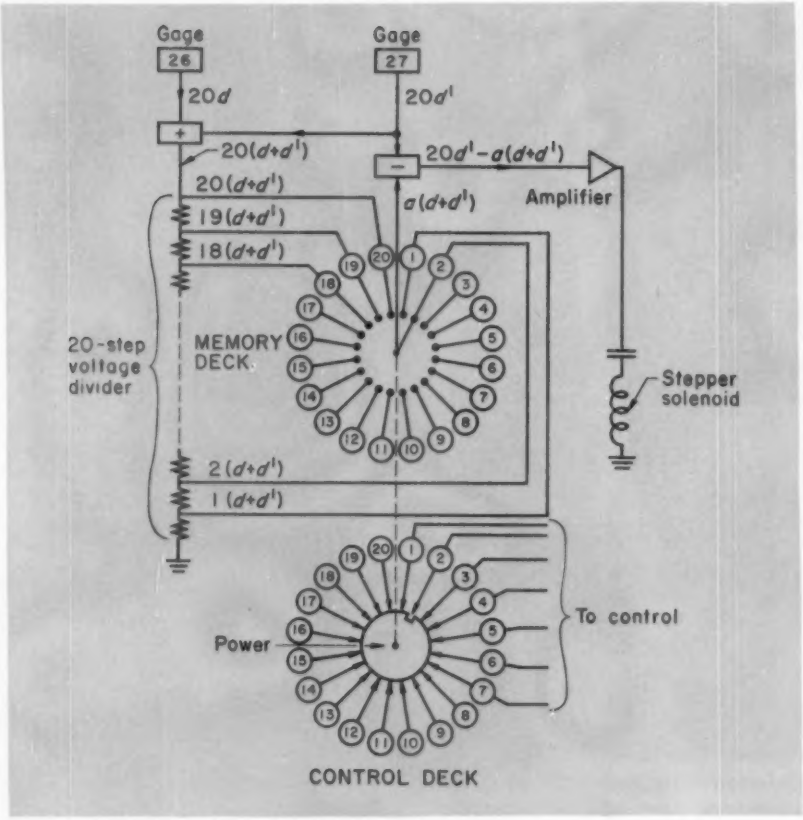

Fig. 2. Computer circuit designed to solve the equation for a fixed lamination stack thickness composed of two variable-sized stocks.

computer must often process other information and decision work as well. For on-line operations such as process control or quality control, the computing functions are an integral part of the operation. For these conditions, it is usually advantageous to employ special-purpose computers. Both digital and analog techniques are used, depending upon the specific requirements of the operation. To illustrate the methods used in fitting decision-making equipment to manufacturing operations, examples from the experience of Austin Electronics are appropriate. These are in-line computers for manufacturing operations, using both digital and analog techniques of automatic decision-making.

Computing Lamination Stacks: In manufacturing stacks of motor laminations to close tolerances, in-process calculations are required when the thickness of a lamination is not commensurate with the final stack thickness and when the sum of lamination tolerances might exceed allowable stack tolerance. This need for in-process calculating was encountered in planning production equipment to produce 20-lamination stacks to a final stack thickness of 0.370 ± 0.002 inch. The nominally required stock, 0.0185 ± 0.0001 inch, was not available, but the nominal size was bracketed by 26-gage stock (oversize, 0.0188 + 0.001 — 0.000 inch) and 27-gage stock (undersize, 0.0172 + 0.001 — 0.000 inch). Final stack size could be achieved by mixing both stock sizes in the stack, the amount of each size varying and dependent on actual stock thickness.

The machine was designed to be fed from both right and left-hand sides to utilize both gages of stock. How many times to feed from the left and how many times to feed from the right could be determined by an operator. The decision procedure would be to gage each size of stock at the point where the coil feeds into the machine, consult a nomogram for determining the amounts of right and left-hand feeding needed, and to control feed into the machine accordingly. However, production requirements demanded that the machine be run at 100 strokes per minute, with no idle time.

Analysis revealed that a digital computer was required to do the calculation necessary, basically because any answer requiring a fraction of a sheet could not be tolerated. The answer had to be composed of whole numbers of each stock size. The calculation required is $ad = (20-a)d'$, where a is the number of oversize pieces of stock required, d is the positive deviation of oversize stock and d' is the negative deviation of undersize stock. The

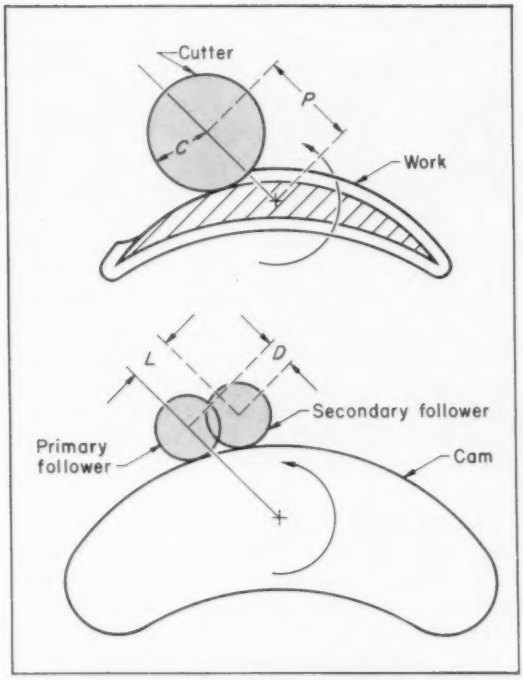

Fig. 3. Geometry of milling turbine blades from a master cam. Equations are derived to maintain a constant feed rate by varying rotational velocity.

Glossary of Terms

Analog Computer. Much like a sliderule, the analog computer performs its operations by setting up analogies for the variables involved and operating on the analogies. The computer elements can be cams, levers, gears, linkages, voltages, currents, pressures and flows.

Digital Computer. Depends on devices having two stable states for its internal operations. A switch can be on or off, a relay energized or deenergized, a tube conducting or nonconducting, to perform computing operations.

General-Purpose Computer. Like general-purpose production machines, these computers have broad areas of application such as routine business calculations, scientific calculations and systems analysis.

On Line and Off Line. Any step directly involved in a process is an "on-line" operation, such as continuous thermostatic control of a furnace temperature. Any step not directly involved in a process is an "off-line" operation such as sharpening drills and cutters used in production.

Special Purpose Computer. Like special machines and tools, these computers are designed for a single purpose only. An example is the wattmeter, it provides an indicator reading proportional to the product $EI \cos \theta$.

equation states that when oversize deviations is equal to undersize deviations then the stack will be of normal thickness. In addition to calculating, the computer circuit needs a memory to retain the value long enough to feed this number of strokes.

The computer circuit devised is shown in *Fig.* 2. Gage outputs, proportional to d and d' are multiplied by 20 and added in a summing network. At the same time, the signal proportionate to $20d'$, the undersize deviation, is fed to a comparison network whose output drives a stepper solenoid. As the stepper switch wiper moves, it successively feeds increasing signal levels tapped from the 20-step voltage divider. This signal is subtracted from the comparison circuit till its output is zero and the stepper is then no longer actuated by the solenoid. The circuit has solved the equation at this point, and has stored the result by the position of the stepper switch wiper. The second deck of the stepper switch, being mechanically connected to the memory deck, is in the same position and is used to handle the higher power levels needed to control the right and left-hand machine feeds. The gaging, computing and controlling is repeated for each cycle of 20 punch strokes and the time required does not interfere with achieving production rates.

Analog Control Computer: A considerably different kind of calculation is required for controlling the rotational speed of a work drive spindle on a cam follower turbine blade milling machine. The milling cutters follow the same pattern on the workpiece that the follower traces on the cam. If the work spindle were to rotate at a uniform velocity, the feed rate or chip load would be anything but uniform. The geometry involved is shown in *Fig.* 3. The cutter travels in and out on a radius passing through the workpiece center of rotation. The cutter periphery contacts the work at successive points whose locus in the finished contour desired. The feed rate is the rate at which the point of instantaneous contact travels along this locus. For instance, the contact point dwells at the tip of the blade during a spindle rotation of about 90 degrees. Uniform feed rate can be achieved by continuously varying the angular velocity of the work spindle.

An analysis of the geometry developed an equation solvable by analog computer techniques. The computer shown in *Fig.* 1 maintains a constant feed rate by varying the angular velocity of the work spinde. Fixed inputs to the computer are set up for each job using the large dials visible in *Fig.* 1. These are S, the feed rate, B, the base circle radius of the cam used and C, the radius of the cutter used. Three varying inputs required to solve the equation are sensed at the machine. These are

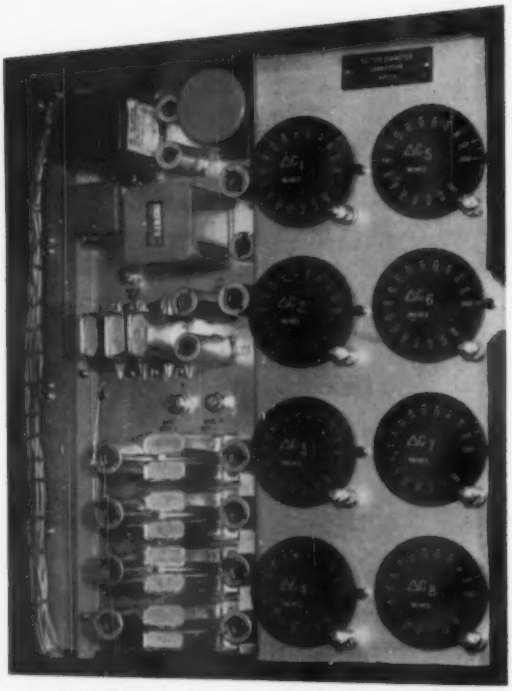

Fig. 4. In-line analog computer that constantly compensates for variations in milling cutter diameter caused by regrinding as the cutters wear.

P and D, shown in *Fig.* 3, and θ, the work spindle velocity. With these inputs, one group fixed during setup of the machine and the second group of inputs generated by the machine, the computer continuously solves the equation. Its output signal causes either acceleration or deceleration of the work through a servomechanism that controls a variable-displacement pump.

After a number of pieces have been milled, cutters require grinding, which reduces cutter radius. To maintain the blade shape desired, the cutter head must be offset for a change of ΔC in cutter radius from the original cutter radius for which the cam and follower were calculated. The computer shown in *Fig.* 4 consists of 8 multipliers to compensate for changes in cutter radius for each of the 8 work spindles. Each multiplier is set by the dial calibrated in inches of ΔC. A term in the basic equation is appropriately multiplied by ΔC to automatically correct operation of the machine for changes in cutter radius. If eight cutters have eight different radii, all pieces nonetheless duplicate the cam contour within the inherent precision of the machine.

Whether on line, off line, analog, digital, general purpose or special purpose, computers are typified by the speed and accuracy of their decision-making. Development of the computer technology places new capabilities at the disposal of manufacturing engineers. To obtain the efficiencies available from automatic decision-making equipment, there must first be an awareness that these capabilities exist, that computers are another useful production tool. Analysis of a specific operation can then proceed in a conventional fashion as for any piece of manufacturing equipment.

From Paper 366, "Special Purpose Computers for Manufacturing and Manufacturing Planning," presented at the 1961 ASTME Engineering Conference. Copies of the complete paper may be purchased from Society Headquarters.

Erecting Antennas in Space

Aboard satellites being launched into space, the amount of room available and the cost of lifting weight impose stringent limitations on the design of components for the satellite. These limitations are felt more seriously in the design of antennas for satellites—antennas that must be of considerable size and a specific shape to receive and transmit information over great distances with efficiency.

Two major types of design have been employed—mechanically erected and pressure-erected. Each design type launches the antenna in a collapsed form that is expanded when the vehicle is in orbit. The mechanically erected antennas use cables, springs, gas pressure and so forth to erect the antenna. An example is the rose petal reflector, a radially segmented circular-parabolic reflector that was folded around the nose of a satellite instrument package. Design and production of these antennas is relatively straightforward, but limitations occur in the ratio of collapsed-to-expanded size.

Erection by pressure, using a Bourdon tube principle, allows a much greater ratio in the collapsed-to-expanded size. The antenna is inflated when the vehicle is in orbit, much like a balloon. Inflated by six pounds pressure, the material is sufficiently rigid to maintain its shape after micrometeorites have punctured it and relieved the internal pressure. Aluminum-coated Mylar film has been used successfully. Collapsed, a 12-ounce antenna is about the size of a cantaloupe. Expanded to an 8-foot diameter, it gives good radiation and impedance performance over the frequency range used.

REFERENCE SHEET

machining plastics

By George C. Carlyon

Vice President, Manufacturing
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FOUR THERMOPLASTICS are finding increasingly widespread use for mechanical applications, both in tooling equipment and end products. These four plastics—Nylon, TFE fluorocarbon (Teflon), Acetal (Delrin) and Lexan polycarbonate—can be machined readily on conventional metalworking machines, often to closer tolerances than are obtainable by molding.

As a group, the mechanical thermoplastics should be machined using techniques similar to those normally associated with the working of free cutting brass or aluminum, making some allowance for the different physical characteristics of the plastics. All four of the materials are thermoplastics and melt at lower temperatures than metals. Thus frictional heat buildup should be avoided whenever possible by using water base coolant and sharp tools. Lexan polycarbonate can be excepted somewhat from this observation and can be machined dry, using conventional metalworking tools. The other three plastics require a modified tool geometry, as indicated in the accompanying tables.

Nylon and Teflon are abrasion resistant and flexible, and require sharp tools to achieve a good bite. In turning and shaping, a radius on the tool point is recommended to improve finish, ranging from $\frac{1}{32}$ inch for Lexan and Acetal, and from $\frac{1}{16}$ to $\frac{1}{8}$ inch for Nylon and Teflon. Carbide tools generally perform better and should be diamond lapped. In drilling, special bits should be used for Nylon and Teflon, while Lexan and Acetal are best worked with conventional drills. Wide polished flutes are recommended to ease chip removal. Oversize drills may be required in Nylon and Teflon to counteract their tendency to flex away from the bit and leave undersized holes when the drill is removed. In through-hole drilling of Nylon, Teflon and Acetal, feed should be lightened toward the bottom to prevent breakout. All four plastics can be readily sawed using metalworking hacksaws and coolant. Coolant is also recommended in bandsawing and circular sawing when feeds are heavy or speeds are slow. Hand feeding is often more successful than mechanical feeding, since "feel" can prevent overheating. Grinding is not difficult as long as open grit wheels are used with adequate coolants and light feeds to minimize heat buildup in the plastic.

Table 1—Turning with High-Speed Steel Tools

Work Material	Side Relief Angle (deg)	End Relief Angle (deg)	Back Rake Angle (deg)	Side Rake Angle (deg)	Speed (fpm)	Feed (ipr)
Lexan	3	3	0-5	0-5	500-1000	0.005-0.025
Acetal	0-5	6	0-5	0-3	300-700	0.003-0.015
Nylon	10-15	20-30	-5-0	0	750-900	0.005-0.010
Teflon	7-30	0.5-10	0-15	0-15	200-500	0.0002-0.010

REFERENCE SHEET

Table 2—Turning with Carbide Tools

Work Material	Side Relief Angle (deg)	End Relief Angle (deg)	Back Rake Angle (deg)	Side Rake Angle (deg)	Speed (fpm)	Feed (ipr)
Lexan	3	3	0-5	-0-5	500-1500	0.005-0.025
Acetal	4-6	4-6	0-5	2-6	400-1000	0.005-0.015
Nylon	5-20	15-25	-5-0	0	1000-1200	0.005-0.010
Teflon	5-20	0.5-10	0-15	0-15	800	0.0005-0.006

Table 3—Shaping

Work Material	Speed (fpm)	Depth of Cut (inch)	Feed per Stroke (inch)
Lexan	315	0.050	0.002-0.70
Acetal	350-450	0.015-0.125	0.015-0.050
Nylon	600-750	0.003-0.125	0.015-0.050
Teflon	600-750	0.003-0.125	0.015-0.050

Table 4—Drilling

Work Material	Helix Angle (deg)	Point Angle (deg)	Lip Relief Angle (deg)	Rake Angle (deg)	Speed (fpm)	Feed (ipr)
Lexan-Acetal	20-32	118	12-15	52	300-800	0.007-0.010
Nylon-Teflon	10-20	70-90	9-15	0	350	0.007-0.020

Table 5—Milling

Work Material	Rake Angle (deg)	Relief Angle (deg)	Speed (fpm)	Feed per Tooth (inch)
Lexan	10-15	3-5	200-350	0.004-0.015
Acetal	10-15	3-5	200-350	0.004-0.015
Nylon	0-10	10-15	200-250	0.008-0.013
Teflon	0-10	10-15	200-250	0.008-0.013

Table 6—Bandsawing

Work Material	Type of Blade	Teeth per Inch	Speed (fpm)	Feed (ipm)
Lexan	Metal	18	1500-1950	10-20
	Plastic	8	17-2000	
Acetal	Metal*	10-18	750-1500	8-12
Nylon-Teflon	Metal†	4-6	12-1500	10-12

*Slight set
†Skip tooth with set

Table 7—Circular Sawing

Work Material	Type of Blade	Teeth per Inch	Speed (fpm)	Feed (ipm)
Acetal	Metal	4-6	800-1200	10-12
Nylon	Metal*	1-2	1500-1800	8-10
and Teflon	Plastic†	4-6	800-1200	10-12

*Carbide tipped with deep gullet
†Hollow ground

General Manager Harry E. Conrad records the progress of "A Productive Year," beginning on page 107.

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Top National Honors Go to Six

FIVE of the world's most distinguished manufacturing engineers claimed the Society's highest national honors during the Engineering Conference and Tool Exposition in New York last week. And a sixth engineer, equally distinguished, received his equally high honor by remote control more than 12,000 miles away from New York City.

Each an outstanding figure in his respective field, these six ASTME Honor Award winners have all greatly contributed to the science and practice of tool and manufacturing engineering. They were selected by the National Honor Awards Committee on the basis of ability and technological achievement.

The engineers who received their medals at the Honor Awards Dinner on May 20 are: Lawrence E. Doyle, Education Award; William W. Gilbert, Research Medal; Robert G. LeTourneau, Progress Award; Albert M. Sargent, Joseph A. Siegel Memorial Award; and Leo P. Tarasov, Gold Medal.

Due to the great distance involved, John Finlay of Australia received the Engineering Citation at a meeting of Sydney Chapter 144. The presentation of the award was made by his son, John B. Finlay, Jr., who is currently chairman of the Sydney chapter.

ASTME
Education Award

Lawrence E. Doyle

. . . he has effectively fostered the stimulating association of students with men in industry, and rigorously advocated raising the professional stature of tool and manufacturing engineers.

ASTME
Engineering Citation

John Finlay

Engineer who has provoked original thinking and energized true progress . . . his part in creating new production facilities and in helping young men to become engineers is of indelible record.

ASTME
Research Medal

William W. Gilbert

Prominent for many years in the field of metalcutting research . . . he is specially recognized for his machinability programs based upon science, but made practical in application.

Recipient of the EDUCATION AWARD, LAWRENCE E. DOYLE, is a professor of mechanical engineering at the University of Illinois. Obtaining his B.S. degree in mechanical engineering at Yale in 1930, he received his M.S. from the University of Illinois in 1949.

Prof. Doyle, a former cochairman of Chicago chapter's professional development committee, originated the idea of ASTME On-Campus Conferences several years ago when he planned and organized the first such conference, held at the University of Illinois. As well known in the publishing world as in the sphere of education, he is the author of two books, *Tool Engineering Analysis and Procedure* and *Metal Machining*, as well as many technical articles appearing in THE TOOL AND MANUFACTURING ENGINEER. During the summers he has held engineering positions at Scully-Jones and Co., IBM and Scholz Construction Corp.

Active in the Society, Prof. Doyle was a member of the National Education Committee from 1952-58 and headed that group from 1953-55.

JOHN FINLAY, winner of the 1961 ENGINEERING CITATION, has provided worldwide thought and progress in production and tool engineering.

After training in the United States and England, Finlay took control of production of drop forging dies, press tools and heat treatment at Australia's newly established Small Arms Factory. Faced with the challenge of World War II on becoming manager in 1940, he organized ten feeder factories and established a permanent training program for apprentices. In 1920 he brought the first jig borer into Australia along with the first thread grinder and pyrometer.

In recognition of Finlay's interest in training young engineers and encouraging them to join technical institutions, a scholarship bearing his name is granted yearly by The Institute of Production Engineers. He possesses other honors too—the Order of the British Empire, bestowed upon him by the queen for services to Australian industry, and an honorary membership in England's Institute of Production Engineers, the first ever awarded outside England.

WILLIAM W. GILBERT, who received this year's RESEARCH MEDAL, manages the Machinability Development Service at General Electric Co. As a member of the central manufacturing staff, he is responsible for the development and application, on a company-wide basis, of new machining technology.

One of Dr. Gilbert's most outstanding developments is the nationally known machinability program Hi-E (high efficiency). As part of the program, which substantially reduces production time taken up by machine operation setup and planning, he designed a machinability sliderule to duplicate a computer that takes into account some 19 of the basic variables in the machining process.

Current chairman of ASME's committee on Standardization of Tool Nomenclature, Dr. Gilbert has also headed ASTME's Schenectady chapter and served on the National Edution Committee. He received ASME's Blackall Award in 1956 for his co-authorship of a paper, "Forces and Power Required To Turn Aluminum and Seven Other Alloys."

ASTME Progress Award

Robert G. LeTourneau

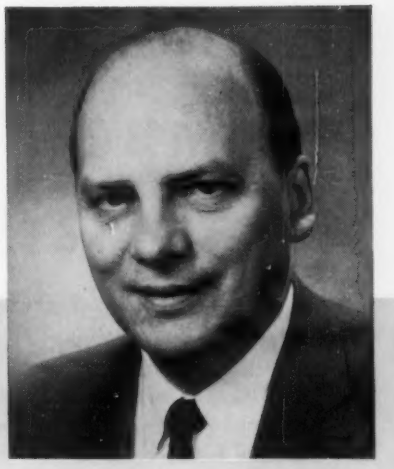
. . . his inventiveness, vision and determination have vastly enriched man's productive abilities through development of new concepts in mobile transportation earth-moving equipment. . . .

Joseph A. Siegel Memorial Award

Albert M. Sargent

A founding father of the Society . . . the Society owes much of its effectiveness to his leadership in organization, soundness of objectives and service to the membership and to the world.

ASTME Gold Medal



Leo P. Tarasov

. . . out of his significant research, chiefly in the area of grinding, industry has greatly benefited from a most extensive body of extant literature upon abrasive metal removal.

ROBERT G. LETOURNEAU, this year's recipient of the ASTME PROGRESS AWARD, has not only kept up with progress but has anticipated it and made it possible. Besides managing his own company, he has for many years designed his plant's production machinery, such as lathes, presses, and milling machines, many of which have been widely accepted in industry.

As founder and president of the R. G. LeTourneau Co., Inc., most of his inventiveness and drive has been directed to land-clearing and earthmoving equipment. The armed forces felt his influence in the form of portable bridges, aircraft crash removal vehicles, snow trains and rocket transporters. Due to his development of the mobile tree saw and a tree crusher, the jungles of Africa and South America were penetrated.

The holder of over 250 U.S. patents, LeTourneau has received the Franklin Institute's Frank P. Brown Medal for "revolutionary improvements in earthmoving equipment, with vast benefit to public works and private building construction."

For his outstanding service to the Society, ALBERT MARDEN SARGENT, one of the organization's founding fathers and its national president in 1946-47, merited the JOSEPH A. SIEGEL AWARD.

Secretary during the first five years of the Society's existence, Sargent also served on the board of directors for eight terms and has held membership on the National Standards, Editorial, Progress, and Constitution and By-laws committees. He was instrumental in the revision of the original Society Constitution and was first to donate to the Research Fund. As head of the Building Fund Committee, he oversaw the financing of the present ASTME headquarters facility.

Sargent, who is presently owner of A. Sargent Consulting Engineer, founded the Pioneer Engineering and Manufacturing Co. in 1931. "In recognition of his outstanding service to the nation and because of his many contributions to the engineering profession," the Lawrence Institute of Technology conferred on Sargent in 1947 its highest honorary degree, Doctor of Engineering.

Winner of the 1961 GOLD MEDAL, LEO P. TARASOV is a member of the research staff at Norton Co. After receiving his D. Sc. degree from Massachusetts Institute of Technology in 1937, he worked three years at the General Electric Research Laboratory, studying the magnetic properties of silicon steel.

Dr. Tarasov's chief concerns at Norton have included the development of improved methods of analyzing damage in ground surfaces; the effects of grinding and of abrasive tumbling on residual stresses and fatigue strength; and the development of the concept of grindability and its application to various materials.

A prolific writer in his respective fields, Dr. Tarasov has been published extensively in *Physical Review, Journal of Applied Physics, Grits and Grinds, Iron Age, Industrial Diamond Review, American Machinist, Australian Manufacturer* and THE TOOL AND MANUFACTURING ENGINEER. He has served as chairman of Worcester chapters of both ASTME and ASM and spent four years on the Society's National Editorial Committee.

Canadians Size Up Competitive Manufacturing

ENGINEERS at the third Canadian On-Campus Conference took a soul-searching look at competitive manufacturing in Canada and faced up to a multitude of problems. But the program's panel of experts left no doubt about the possibility of solutions.

"Why Are We in Trouble?" A. L. Stopps, president of El-Met Parts Ltd. and lead-off speaker at the conference, asked the question in the title of his talk, then said the major clue was the word "competition." In sports, he explained, competition means a contest between rivals within one specific classification. In manufacturing, competition on a world basis requires three prime factors: government understanding with action, volume and costs. Canadian secondary manufacturing, he continued, is completely lacking on all three counts.

Stopps' remedy for the situation revolves around regulation of foreign trade. "In no way," he declared, "can we permit foreign trade to weaken Canada's industrial base." Imports and exports should be controlled and balanced by categories, he said, and it must be made more profitable to produce goods in Canada for the Canadian market.

Sponsored by the Canadian chapters of ASTME in cooperation with the engineering faculty of McMaster University, the conference went a long way toward alleviating Canada's manufacturing problems by bringing them to the attention of the nation's engineering community. And it went another big part of the way by pointing out how to meet and overcome these problems. Perhaps that is why the 200-plus registrants went home feeling their day at McMaster University was well spent.

Take Giant Steps

Another conference speaker, L. S. Magor of Retor Developments Ltd., urged Canadian manufacturers to take giant steps in the improvement of methods and technical processes. The little steps, he said, will probably be outdated and outmoded before they have realized any worth-while savings.

Canadian Westinghouse's R. McCormick, speaking on the economics of make or buy, told the group that a periodic review of all products for cost improvements is necessary if manufacturing is to remain competitive, produce a profit and give the company an adequate return on investment. The lack of development activity in Canada's secondary manufacturing, he stated, is causing many engineers to seek employment in other industries.

Not only are Canadian engineers leaving the manufacturing industry but they are leaving Canada "to go where the basic research is being done," said S. H. Deeks, executive director of the Industrial Foundation on Education. In a talk on "How Can Trained Technologists Assist?" he emphasized the fact that educators cannot produce adequately and properly trained technologists without the close cooperation of industrial employers, who know the needs that must be filled.

Luncheon speaker J. S. Keenan of Canadian General Electric Co. Ltd., pointed out that each year Canada imports $4500 million worth of manufactured goods, yet 10.6 percent of her work force is presently unemployed. This, he said, calls for a campaign to "buy Canadian."

In the field of labor relations, J. H. McGivney, director of personnel at Chrysler Corp. of Canada said, management must give more assistance to foremen and supervisors and must carry out its responsibility of discipline.

The conference, chairmanned by Harry B. Ward of Hamilton District chapter, concluded with a lively panel discussion, further attesting to the Canadians' determination to solve their competitive manufacturing problems. As one Canadian engineer put it: "We have the capital, tools, knowledge and technicians to compete with other nations and among ourselves; now we must work for more technical education, a stronger and alert representation in all levels of government and a more realistic depreciation allowance to enable our industries to replace obsolete machines and methods."

H. R. Roberts (left), publicity chairman for the third Canadian On-Campus Conference, and speaker A. L. Stopps discuss the engineer's responsibility in raising Canada's standard of living and production of goods.

Planning for You

Planning is the number one function in the science of management. Planning is setting objectives, forecasting future conditions and determining the courses of action required to attain the objectives in light of forecasts made.

That is just what your Society management—officers, directors and staff—have been doing this past year. In April of 1960 we established objectives and organized committees and staff to carry out courses of action to attain these objectives. In light of business conditions existing during the past year, I think a pretty good job has been done. The details are presented in these pages.

During the year, the ASTME Long Range Planning Committee completed its assignment and its report has been submitted to you. I hope you will get as enthusiastic about our plans as we are —plans to provide you with the educational opportunities and facilities to keep up with the headlong pace of technological advance in our strategic profession of tool and manufacturing engineering. The men who have planned the long range objectives of the Society think they will result in being a monumental milestone in the history of your Society. With your participation, they will.

Dale Long

PRESIDENT

American Society of Tool and Manufacturing Engineers

A PRODUCTIVE YEAR
—*the ASTME 1961 Annual Report*

This has been a year of real progress for your Society—of progress not only in terms of membership growth, but in terms of more and better services to members and to all of industry.

In this report, I'm going to tell you about some of the major accomplishments of your Society since April 1960. As you read this record of progress, I am sure you will be proud of your association with an organization that has achieved so much and that, not standing on its laurels, plans even bigger things for the future!

Chapters, Membership at All-Time High

One of the strongest evidences that ASTME has a great deal to offer to tool and manufacturing engineers everywhere is the formation of new chapters. In recent months, eight senior chapters have been organized—Chattanooga, Tenn.; Danbury, Conn.; Huntsville, Ala.; Skokie Valley, Ill.; St. Paul, Minn.; Adelaide, Australia; Manila, Philippine Islands: and Mexico City, Mexico. This brings the total of senior chapters to 172.

Added to these new senior chapters are six new student chapters—Detroit Engineering Institute, Detroit, Mich.; Flint Junior College, Flint, Mich.; Muskegon Community College, Muskegon, Mich.; Pennsylvania State University, University Park, Pa.; Western Michigan University, Kalamazoo, Mich.; and Oregon Technical Institute, Klamath Falls, Ore. Your Board of Directors has also approved a charter for a student chapter at Temple University.

As this is written, ASTME membership has reached its all-time high—well over 41,000. This means that your Society has more than doubled its membership during the past 10 years. Growth this year is particularly strong in the midwestern and southern states, with substantial gains in all regions of the country except for a very minor downturn in the Far West, where temporary economic conditions have not favored Society growth.

This nuclear reactor component is being machined at Westinghouse Electric Corp. Basic machining data made available through ASTME is often a factor in the success of operations of this kind.

Because your Society's growth is somewhat responsive to economic conditions, the fact that new chapters have been formed and new members gained during a recession period is an indication of the fundamental strength of ASTME. And with the expected upturn of the economy, ASTME should continue its long-term expansion at an accelerated rate.

Incidentally, it has been estimated that attendance at ASTME chapter meetings during 1960-1961 has been well over 200,000. This, too, is probably a new record and it indicates the high merit of chapter programs.

Added to this greater attendance at chapter meetings is significantly greater attendance at other ASTME meetings—seminars, symposia, on-campus conferences, literally hundreds of diversified activities intended to promote greater manufacturing efficiency.

Detroit Tool Exposition Sets Records

Attendance at ASTME's Detroit Tool Exposition also set a new record. More than 40,000 engineers and executives crowded Detroit's Artillery Armory during the week-long exposition in April 1960. There were 560 exhibitors, who displayed thousands of new products of interest to tool and manufacturing engineers and manufacturing executives.

Your West Coast Tool Exposition in November 1960 also was a pace-setting event, with an attendance of 11,000 and 260 exhibitors.

ASTME's New York Tool Exposition—May 22-26—will have no fewer than 300 exhibitors. Anticipated attendance is about 40,000, which will be a record for a tool exposition in New York City.

With tool expositions in Detroit, Los Angeles and New York City during a 13-month period, ASTME has made it possible for tool and manufacturing engineers from coast to coast to see the latest developments in machines, tools, tooling and manufacturing equipment of all kinds.

The 1962 Tool Exposition will be held in the Municipal Auditorium, Cleveland, Ohio. Dates for the Cleveland Tool Exposition are May 7-11, 1962. Cleveland, like Detroit, is in the heartland of industrial America, and engineers from the entire nation are already looking forward to attending the Cleveland Tool Exposition. An exceptionally wide range of exhibits will be displayed, with special emphasis on new machines and manufacturing equipment.

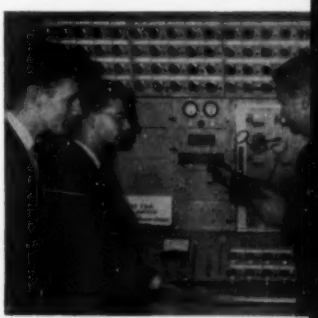
Engineering Conferences Well Attended

As you know, your Society sponsors engineering conferences concurrently with its tool expositions. These events, which include plant tours, talks by nationally known authorities on new developments in tool and manufacturing engineering, and seminars and symposia related to the manufacturing engineering sciences, help participants to obtain a well-rounded picture of processes and methods they can apply in their own plants—with cost-cutting results.

To give you an idea of the scope and extent of engineering conference programs, the Detroit program included 63 engineering talks, 17 plant tours and a dimensional metrology seminar. There were 25 engineering talks at the West Coast Engineering Conference. This conference was notable for its Techtours—tours in which engineering discussions of new developments such as numerical control were followed by visits to plants where the new developments were seen and demonstrated at first hand.

The New York Engineering Conference, with over 50 talks covering explosive forming, advanced metalcutting, the use of computers in manufacturing, to name just a few subjects, promises to be of outstanding interest and merit. Nine plant tours and three Techtours are planned.

Anyone in industry can benefit from the presentations at these engineering conferences. Attendance is open to all, of course. But, even more important, each of the talks is published by your Society, thus becoming part of the enduring literature of the manufacturing sciences. Many thousands of copies of these papers are ordered each year and copies of the collected papers of ASTME engineering conferences are a staple item in most industrial and engineering libraries throughout the world.



ASTME activities have helped to interest thousands of students in a career in science or engineering. Here Chapter Chairman Harry A. Williamson explains the operation of an analog computer to several students at a Monmouth Chapter industry and education night.

Seminars Attain New Stature

ASTME Creative Manufacturing Seminars—short postgraduate courses in advanced manufacturing—have attained a new stature during the past year. There were ten of these seminars during 1960-1961, covering high energy rate forming, metalcutting today, quality control for improved production, machining and forming of Space-Age materials, automation and numerical control, die design and press tooling, plastic tooling today, and operations research. Two of these seminars were in Chicago, with others being held in Atlanta, Ga.; St. Louis, Mo.; Dallas, Tex.; Hartford, Conn.; Detroit, Mich.; Philadelphia, Pa.; Cleveland, Ohio; and New York City.

More than 20,000 copies of the 180 seminar papers have been distributed during the past few months and articles based on them have appeared in a number of magazines. Thus the seminar presentations, like the engineering conference talks, have become an essential part of the literature of the manufacturing sciences. Your National Headquarters maintains a large stock of copies of all papers so that orders can be filled immediately.

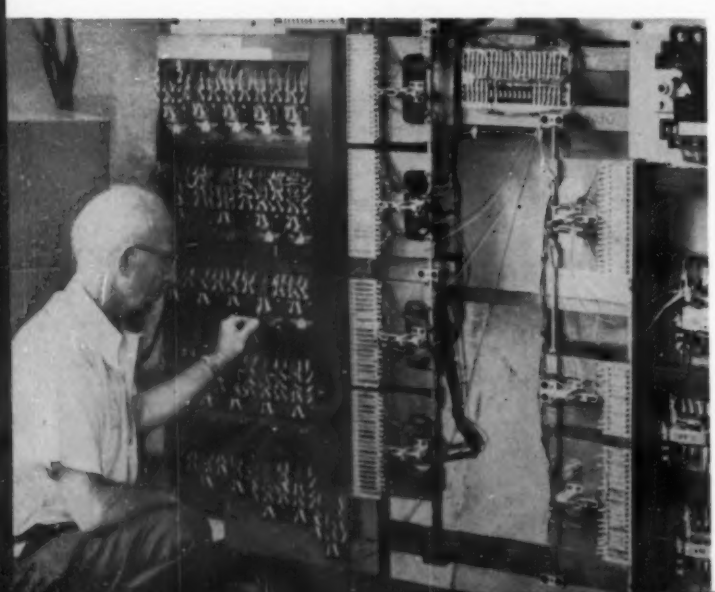
New Handbooks to Fill Industry Needs

Sales of your Society's basic handbook, the 2289-page **Tool Engineers Handbook**—which was completely revised in 1959—continued at high levels during 1960-1961. The **Die Design Handbook** and **Tooling for Powder Metal Parts**—ASTME's two other basic reference books—continue to be best-sellers in their respective fields.

These three books will soon be joined by others—a **Jig and Fixture Design Handbook**, a **Handbook of Process Planning and Estimating**, and books tentatively titled: **Machining With Carbides and Oxides, Numerical Control in Manufacturing**, and **Tooling for Aircraft and Missile Manufacture**. Your Society's first textbook—**Fundamentals of Tool Design**—is also in preparation.

Copy for all five of the new handbooks is being edited simultaneously and completed manuscripts will be sent to the publisher within the next calendar year. Subject to the publisher's production schedule, three of the five handbooks may be off the press by the end of 1961. The tool design textbook should be printed by early 1962.

The need for these books was established by a survey of ASTME members and industry. Hundreds of experts are contributing their time, talent and know-how in preparing the books, which will be the best of their kind.



Present-day requirements for 100 percent product reliability have led to the development of advanced inspection techniques. Here a machine tool control panel is being automatically run through its paces by a tape-controlled inspection machine. Tool and manufacturing engineers are responsible for the selection of inspection methods and the design of inspection instruments and machines. Dozens of the talks delivered at ASTME engineering conferences and seminars during 1960-1961 dealt with inspection and measurement, as did articles in THE TOOL AND MANUFACTURING ENGINEER.

Magazine Continues Leadership

During the calendar year 1960, your Society's engineering journal, THE TOOL AND MANUFACTURING ENGINEER (formerly THE TOOL ENGINEER), published 13 issues, containing a total of 3882 pages. This figure included the largest number of editorial pages ever published by the magazine in one year. As always, the magazine maintained the highest standards.

The change in name of your magazine from THE TOOL ENGINEER to THE TOOL AND MANUFACTURING ENGINEER, which took place with the September 1960 issue, was made to more closely identify the magazine with the Society. The editorial coverage and approach remain unchanged.

In addition to its comprehensive coverage of engineering subjects, the magazine published 261 pages of ASTME news—the equivalent of a 600-page book. Hundreds of chapter, as well as national, events were covered.

The growing prestige of the magazine—and of your Society—is evidenced by the number of times statements appearing in the magazine were quoted by major newspapers and magazines throughout the country during the course of the year. Also, many of the magazine's articles were reprinted by industry and widely distributed. In total, these reprints amounted to over 380,000 individual magazine pages.

Your magazine is now recognized as one of industry's most important working tools—a tool that is needed by anyone who must keep up to date, month by month, on the science of manufacturing.

Since last April, the magazine has published four special issues—April 1960 (Detroit Engineering Conference and Tool Exposition), June 15, 1960 (Manufacturing Planning issue), September 1960 (Machine Tool issue) and March 15, 1961 (Manufacturing Planning issue). The May 1961 issue will be a special issue as well, with expanded engineering article coverage and comprehensive treatment of the new developments to be seen at the New York Tool Exposition plus complete Engineering Conference coverage.

The year 1960 saw the introduction of many radically new machine tools, like this Warner & Swasey tape and memory controlled turret lathe. ASTME members learn of these developments through the pages of THE TOOL AND MANUFACTURING ENGINEER and through seeing them in action at ASTME tool expositions.

Cooperation with Educators Paying Big Dividends

There are 36 student chapters in technical institutes, colleges and universities all over the country, with new ones being added constantly. These chapters have played an important role in creating interest in careers in tool and manufacturing engineering on the part of engineering students.

On-campus conferences, too, are helping to generate interest in tool and manufacturing engineering. During the year, 15 of these conferences were held, with an estimated total attendance of more than 2000.

Throughout the year, ASTME chapters and individual members have been active in sponsoring and encouraging the development of Junior Engineering Technical Society—JETS—chapters in high schools. This close working relationship with JETS has undoubtedly encouraged many secondary school students to consider engineering as a career, and has focused attention on the opportunities in the tool and manufacturing engineering field. We anticipate even greater activity in this area in the future.

Incidentally, a JETS chapter sponsored by ASTME's Lancaster, Pa., chapter was recently selected as one of the outstanding JETS chapters in America.

Society Attains Wide Recognition for Standards Work

With the advent of the Space Age, industrial and manufacturing standards of all kinds have taken on new importance. Consequently, your Society, which has always emphasized the need for greater standardization, has maintained a high level of activity in this field.

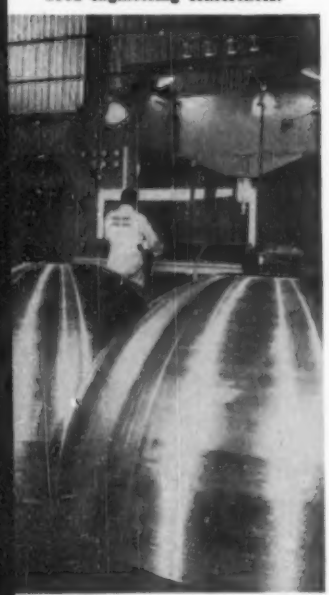
During the past year, ASTME has continued to cooperate with the American Standards Association in its efforts to develop new standards where they are needed and to keep current American standards up to date. Your Society was recently appointed as sponsor for the ASA sectional committee on the decimalized inch. An organizational meeting has already been held. ASTME is also sponsoring a sectional committee that is actively working on standards for the materials used in jigs, fixtures and gages.

Standards committees in dozens of ASTME chapters are actively working on the review of existing American standards and the development of new ones. ASTME has been warmly commended by ASA for this work.

Research Fund Completes Two Big Projects

The period 1960-1961 saw two major ASTME research projects reach completion. The first of these was the publication—in book form—of ASTME's authoritative **Metal Cutting Bibliography**. This 1000-page volume, representing four years' of research by The John Crerar Library in Chicago—research sponsored by ASTME at a cost of $50,000—contains 5593 abstracts of original articles on chip-producing processes and reviews 18,000 books, articles and papers pertaining to metalcutting during the period 1943-1956.

"If you don't put metal on, you don't have to take it off." That's why the tool and manufacturing engineers who selected fabrication methods for these missile domes chose spin forging—a new process in which heavy metal is spun like clay on a potter's wheel. These parts are made at Hufford Div. of the Siegler Corp. in Los Angeles—one of dozens of plants visited by ASTME members during 1960-1961 engineering conferences.



Although this is the most authoritative metalcutting bibliography in the world, developments are being made at such a pace that there is a real need for further work to keep the bibliography current. It is hoped that your Society can obtain funds for this much-needed service to industry. Ford Motor Co. has already offered $5000 for this purpose—a gift that is contingent upon the receipt of other gifts toward the $13,000 needed to fully up-date the bibliography so that it can better serve industry's needs.

This year also saw the completion of a $27,000 ASTME-sponsored project at Syracuse University to investigate the punchability of silicon steels. The findings, which will be of considerable value to industry, have already been published in ASTME Research Report 30.

Work is now starting on an arc-welding research project, cosponsored by your Society and the Welding Research Council. Work on this project will be accomplished at Syracuse University.

Your Society has always maintained that research results are of little value until they are widely disseminated. For that reason, it recently distributed bound volumes containing all ASTME Research Reports to more than 180 college and university libraries.

As you probably know, most ASTME research projects have been partially supported by industry grants, with ASTME paying the administrative costs. In this way, all money in a grant is applied directly to research. If our current drive for industry funds is successful, we should be able to initiate many new research projects of general value to industry.

ASTME Affiliates with AAAS

An event of major importance during 1961 was the affiliation of your Society with the American Association for the Advancement of Science (AAAS), one of the oldest and largest groups of scientists in this country.

The affiliation of ASTME with AAAS serves to emphasize the growing link between the so-called "pure" sciences and the engineering sciences. With today's accelerating rate of development in both science and engineering, only a few months may separate the conception of an idea by a scientist and the realization of that idea in terms of a practicable engineering design. Consequently, scientists and engineers have learned to work closely together.

Affiliation with AAAS means that ASTME will cooperate even more closely with fellow-members of the scientific community on projects of mutual interest.

Society's Financial Structure a Sound One

The sound financial structure of your Society is apparent from a study of its balance sheet. Net worth as of March 1, 1961 is over $1 million. You'll also be interested in the expense per member per year and income per member per year figures, as shown below the balance sheet.

The figures for income and expense illustrate the multiple dividends each member receives in addition to invaluable scientific and technical information. With an average dues payment of $6.60 going to Headquarters (a portion of

ASTME Balance Sheet—February 28, 1961

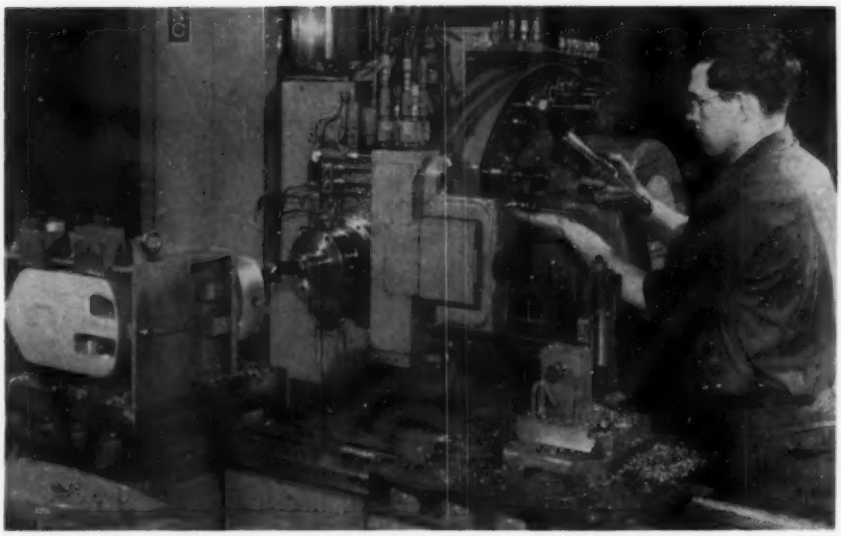
Assets:		Liabilities:	
Cash	$ 56,173.60	Unpaid normal expenses	$ 14,114.28
Treasury bills	199,076.50	Deposits—future business	297,832.00
Accounts receivable	23,616.75	Accrued personnel expenses	3,123.80
Investment fund (At cost)	985,516.96	Unpaid sales commissions	2,023.50
Inventories	55,050.11	Total liabilities	$ 317,093.58
Property and equipment	233,439.80	Net Worth	1,241,941.91
Expense paid in advance	6,161.77		
Total assets	$1,559,035.49	Total liabilities and net worth	$1,559,035.49

Expense Per Member Per Year

Education	$ 1.08
Scholarship, grants and awards	.60
Conferences, science and engineering	7.11
Engineering regulatory research	.15
Standards research	.74
Scientific periodical publications	28.44
Scientific reference publications	2.67
Scientific and technical papers	.70
Technical information services	1.33
Chapter services	.97
Operations (Office, finance, judicial, constitution and bylaws activities, officers and directors)	6.49
Total	$50.28

Income Per Member Per Year

Dues and initiation fees (Member subscriptions not included)	$ 5.21
Conferences, science and engineering	11.87
Scientific periodical publications (Includes member subscriptions)	28.72
Scientific reference publications	1.34
Scientific and technical papers	.34
Investment and miscellaneous	.81
Total	$48.29



The machine tool of the future may be with us today. At least that is what many ASTME members thought when they first learned of this "tape controlled machining center" at ASTME engineering conferences and in the pages of THE TOOL AND MANUFACTURING ENGINEER. Equipped with an automatic tool changer, this Kearney & Trecker machine can perform a complete series of machining operations automatically.

the original outlay for dues is returned to the chapter), each member receives services in various forms from the Society amounting to $50.28, a return many times that of his investment in National operations. These figures are the average for the 1958-1959 and 1959-1960 fiscal years. Average membership for this two-year period was 39,809.

A Look at the Long Range Picture

Times change . . . and with changing times come new industries, new manufacturing processes and methods, and, over the long pull, significant industrial growth.

Your Society too, has to change with the times. That's the thinking behind the appointment of a long range planning committee by your national officers and directors. This committee submitted its final report at the ASTME semiannual meeting last November. Taking into account predicted industrial growth during the period 1960-1975, the committee came up with a number of positive recommendations for the future development of your Society. The complete report of the Long Range Planning Committee was published in the February issue of THE TOOL AND MANUFACTURING ENGINEER.

Just one more thing . . . Although ASTME has grown phenomenally during the past decade, your officers, directors and the people who serve you at National Headquarters have never lost sight of the fact that your Society is not just an organization chart or a financial statement. ASTME's greatest resource is its individual members.

For, in the final analysis, ASTME's growth, its reputation, its future, depend on you—on your enthusiasm for its objectives, on the amount of time and thought you devote to helping ASTME attain these objectives.

If there is any way that ASTME can serve you better, just let us know. And remember that a hearty handshake awaits any ASTME member who drops in at National Headquarters!

Audience participation is the rule at ASTME Creative Manufacturing Seminars. Here some of the enrollees at the plastic tooling seminar held in Detroit discuss some of the fine points of plastic die construction with one of the many experts who conducted the sessions.

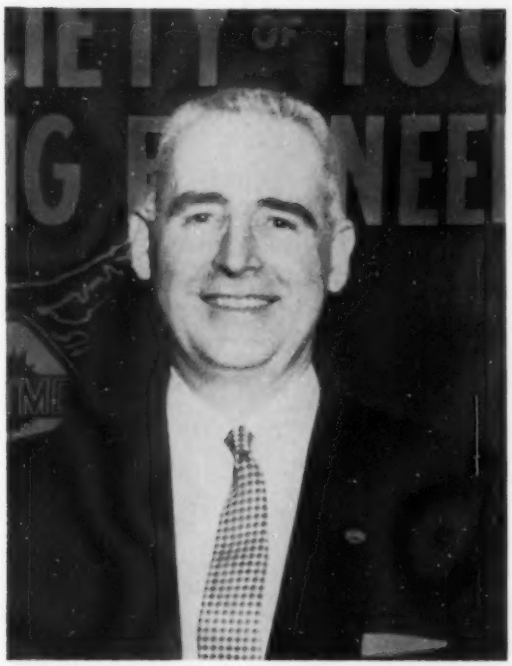
Student Chartering at Western Michigan

KALAMAZOO, Mich.—The chartering of Western Michigan University as Student Chapter 35 highlighted Kalamazoo chapter's annual Ladies Night and installation meeting. H. Verne Loeppert, national treasurer, served as chartering officer and Education Director Gilbert Seeley made the headquarters presentation to Carlton Ferguson, secretary of the new student chapter. Also attending was John Kopplin of the National Education Committee.

Following the chartering ceremonies Loeppert installed the Kalamazoo 1961-62 officers: Charles Robinson, chairman; C. VanderWeele, Jr., first vice chairman; James Rau, second vice chairman; Nathan Miller, secretary; and William Erickson, treasurer. *—Don Massey*

Two new chairmen, Charles Robinson (left), Kalamazoo, and Thomas Schaberg, W.M.U., hold their respective chapter charters. With them are H. Verne Loeppert (right), national treasurer, and Grant Beilfuss, past Kalamazoo chairman.

From Arm Lengths to Wave Lengths



LONG ISLAND, N. Y.—At a recent meeting of Long Island chapter, George J. McLaughlin, a founder and past chairman of the group, spoke on "ASTME'S Role in Standardization." He stressed the strides standardization has taken since the 1100's when the length of any man's arm designated a yard. Today, a perfect meter must be 1,650,763.73 wave lengths of the orange-red line of Krypton 86. *—W. Lamberta*

Antarctic Venture

WORCESTER, MASS.—A land without vegetation was the subject of Rev. Daniel Linehan, S. J., speaker at Worcester chapter's combined Industry-Education and Father-Son Night. Rev. Linehan, director of Western Observatory, has served in the Antarctic as safety engineer, geologist and seismologist for the U. S. Navy Dept.

He told the 64 members and guests that only 0.01 of one percent of the Antarctic is ever without ice or snow throughout the year. Although the ground level is only 9200 feet above sea level, the atmosphere there is equivalent to that at 20,000 feet, Rev. Linehan said. *—Robert Cusson*

Europe, Anyone?

Due to the success of last year's venture, Macomb and Detroit chapters will again sponsor a European tour this October. The itinerary will include four days in Paris, two days in Berlin, and three days in London, Vienna and Rome. The group, which will be limited to approximately 40 people, will travel from New York by Rolls-Royce 707 jet, stay in first-class hotels and tour a number of European factories. Reservations must be made by July 1, and must include a deposit of 25 percent of the total tour cost. For further information, contact Wayne Kay of Macomb Chapter 12.

Seattle Speaker Discusses Numerical Control

SEATTLE, Wash.—Going around in circles as they examine the intricacies of these round structural components are (left to right): Cliff Kelley, Seattle chapter program director; Russell H. Lewis, speaker; and Carl Carlson, chairman. Lewis, who is technical training supervisor at Aero-Space Div., Boeing Airplane Co., defined numerical control as "a flexible production manufacturing concept for automatically controlling a machine's complete work cycle with easily varied coded instructions." ***—Ray Clift***

Lancaster Receives JETS Honor

GREATER LANCASTER, Pa.—An industrial operations tour of Olmstead Air Force Base was just one of many successful projects which recently brought national recognition to ASTME's Lancaster chapter as sponsor of the Junior Engineering Technical Society chapter of Lancaster Catholic High School.

At the second annual JETS Eastern Leadership Conference held at the Republic Aviation Corp., the Lancaster student group received the Outstanding JETS award—the Lamp of Knowledge—and the ASTME chapter received the JETS' Founders Plaque for outstanding sponsorship. The presentations were made by Richard T. Fallow, executive director of the JETS.

New officers of Lancaster chapter are: Fred Long, chairman; Francis Hull, first vice chairman; Norm Ressler, second vice chairman; R. J. Kintzi, secretary; and M. Phelan, treasurer. *—R. J. Kintzi*

An Olmstead Base official points out some interesting features of a tanker plane to (from left to right) JETS James Heroux and Michael Cannizzaro, and Greater Lancaster member James Denuel.

Reports in Brief . . .

Northeast

At CATSKILL REGION chapter's Annual Ladies Night and installation of officers, National Director Joseph L. Petz swore into office George Berk, chairman; Bernard Martin, first vice chairman; Andrew Horvath, second vice chairman; Robert Morris, secretary; and Victor Patience, treasurer. . . . Horace D. Gilbert, president of Miniature Precision Bearings, recently spoke to 100 members and guests of MONADNOCK Chapter 124. . . . YORK Chapter played host to 35 students of Scotland Industrial School on "Scotland School Day," which featured a tour of the Naval Ordnance Plant.

Midwest

A talk by George Davis, metallurgist from Peninsular Steel Co., and a tour of the Peninsular plant were the highlights of MACOMB chapter's April meeting. . . . Officers recently elected to lead the Michigan Regional Council of Chapters are: President Joseph J. Gabrick, Detroit; First Vice Chairman Robert Clare, Grand Rapids; Second Vice Chairman Arthur Reiser, Lansing; Secretary C. D. Wallar, Jackson; and Treasurer Calvin Frappier, St. Joseph. . . . Outgoing officers of RICHMOND chapter were honored at the group's Annual Recognition Night. Incoming Richmond officers are: Everett Heiser, chairman; Eugene Makie, first vice chairman; Paul Vance, second vice chairman; Eugene Foust, secretary; and Frank Jenkins, treasurer. . . . CHICAGO chapter is publishing a newsletter to improve communications between the chapter and its members. "Society Notes" will carry information on both group and member activities. . . . A joint symposium on hardness testing was held by CINCINNATI Chapter 21 and local chapters of ASQC, SNT and ASM. E. Lysaght of Wilson Mechanical Instrument Div. of American Chain & Cable Co., was speaker of the evening. Officers elected to lead Chapter 21 for the coming year are: Frank R. Kutz, chairman; Joseph D. Williamson, first vice chairman; Val Anzalone, second vice chairman; Norman S. Ahlgrim, secretary; Charles J. Kramer, treasurer. . . . Fran J. Sehn, national secretary, recently installed the officers of GRAND RAPIDS Chapter 38: Robert Clare, chairman; Floyd Thompson, first vice chairman; James Bronkema, second vice chairman; Ted Majewske, secretary; John Leese, treasurer. Preceding the installation, Sehn and John Groomes, of ASTME Headquarters, spoke on the Long Range Planning report.

South

Frank F. Ford, national vice president, installed SOUTHEAST FLORIDA chapter's 1961-62 officers: Charles W. Stephenson, chairman; Dick Leonard, first vice chairman; Frank Biel, second vice chairman; Howard Day, third vice chairman; Grant Smedley, secretary; and Sil Chaney, treasurer.

Rocky Mountain

Elliott Kaufman of General Electric spoke to PHOENIX chapter at its combined Ladies Night and Installation meeting. The new officers are: Jim Rost, chairman; Neil Ackerman, first vice chairman; John Stern, secretary; Gib Harwood, treasurer.

positions wanted

MECHANICAL ENGINEER—desires full-time position in Detroit vicinity. Applicant has completed two years of mechanical engineering at Lawrence Institute of Technology and is continuing study for B.S. degree in night school. Experience includes machine shop background and drafting. Write Raymond Chwastek, 4169 31st St., Detroit 10, Mich.

GRADUATE STUDENTS from India, in manufacturing, mechanical and industrial engineering, want summer experience in American industry. These are outstanding men who can solve your problems and be profitable to you. Write to Prof. Thornton Price, M. E. Bldg., University of Illinois, Urbana, Ill.

MANUFACTURER'S AGENT—desires industrial lines for Tennessee, North and South Carolina, Florida, Alabama and Georgia. Contact Taylor Womack, manufacturer's agent, 1416 Willivee Drive, Decatur, Ga. Phone 636-8255.

SEEKING NEW AND INTERESTING "on-the-go" job! Will work and assume responsibility. Have 12 years' experience to offer, consisting of engineering liaison; administrative duties; engineering sales and promotion; plus shop and field service work. Also have M.E. degree and sincere ambition. Advancement is assured! Write to Classified Ads, Dept. 208, 10700 Puritan Ave., Detroit 38, Mich.

Presenting the

PEORIA, Ill.—Presenting Gordon Swardenski (right) with the Society's Award of Merit, H. Dale Long congratulates this past chairman of Peoria chapter for his outstanding leadership. Long also paid tribute to the chapter by pointing out that it has more national representation per member than any other ASTME chapter. ***—R. K. Hohulin***

Photo courtesy Peoria Journal Star

MONTREAL—Some 255 members and guests of Chapter 50 were present to see Creighton McDowell (left) receive the national Award of Merit from Albert Underwood, ASTME director. Presently, McDowell is engaged in the organization of a Quebec City chapter. At the meeting, newly elected Montreal chapter officers were installed and a speech was given by C. G. Schelly of The DoAll Co. ***—Louis Balint***

PORTLAND, Ore.—Fred D. Mondin, of Portland chapter, who has actively served the Society for 24 years, displays the Award of Merit presented to him by Ben Berlien, national director. ***—W. D. Gender***

Award of Merit

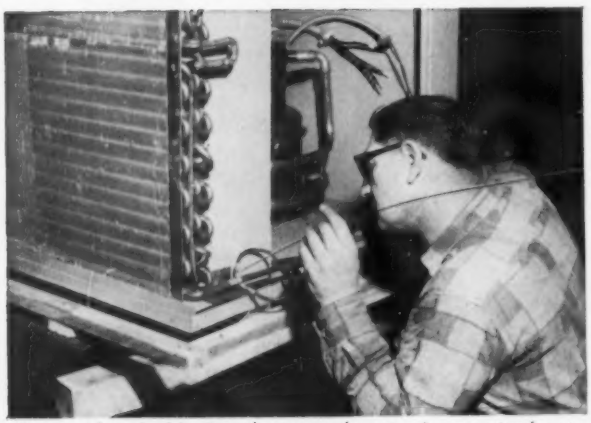
ST. LOUIS, Mo.—Clarence L. Miller (left) accepts the national Award of Merit plaque from Willis G. Ehrhardt at a recent meeting of Chapter 17. The installation of officers by H. Dale Long, the observance of "Old Timers Nite" and a speech by Dr. Merle T. Welshans, Washington University, were other highlights of the program. *—Harold W. Bachman*

LOS ANGELES, Calif.—At a meeting featuring three guest speakers and the presentation of a scholarship to California Polytechnic College, Ben Hazewinkel (right) received ASTME's national Award of Merit. Hazewinkel is pictured with George Tilden, chairman of Los Angeles chapter. *—Brian Mahoney*

WINDSOR, Ont.—William A. Thomas of Windsor Chapter was given a standing ovation as he received the national Award of Merit at a recent chapter meeting. Thomas is shown during his acceptance speech. *—G. F. Burford*

PITTSBURGH, Pa.—Paul H. Magnus II (left) accepts the ASTME Award of Merit from outgoing Chairman Walter F. Coles. Magnus has a long history of service to Pittsburgh chapter. Since joining the group in 1947, he has held the positions of first vice chairman, member of the executive advisory committee and chairman of the editorial committee. *—James S. McAfee*

HOW TO MAKE 4,999 JOINTS WITHOUT FAIL



Here, with a double tipped oxyacetylene torch, operator brazes condenser coil joints. This condenser-compressor assembly contains 30 hook-up joints, not counting return bends.

The unit evaporator, located inside the house, contains 36 hand-brazed SIL-FOS 5 joints.

International Heater Does it With HANDY & HARMAN SIL-FOS 5

Production statistics of this manufacturer of heating and air-conditioning equipment show that perhaps one in five thousand hand-brazed joints may need touching up. This is a micrometer measurement away from absolute perfection.

One of the Utica, New York, company's products is a home air conditioner that utilizes the existing duct work of the structure's hot-air furnace. Its novelty lies in the fact that the unit's compressor and condenser are located outside the house for noise-free coolness inside the home.

The unit's evaporator is installed on top of the furnace for simple tie-in to the plant's ducting for hot-weather operation.

Shown here in production is International's Model 5-5B of 5 ton capacity.

This "joint in quantity" record is being duplicated by SIL-FOS 5 silver alloy brazing in the manufacture of heating, air-conditioning and refrigeration equipment everywhere. Its strength, air-and leak-tightness and ease of application are some of the reasons that make Handy & Harman SIL-FOS 5 brazing one of the **surest** metal joiners in existence. We'd like you to know more about SIL-FOS 5 and the job it can do for you in joining copper and copper alloys in any shape, size and complexity. Our Bulletin 20 deals with this in a complete and informative manner. A request to Handy & Harman, 850 Third Avenue, New York 22, N. Y. will bring you your copy.

Your No. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 850 Third Avenue, New York 22, N. Y.

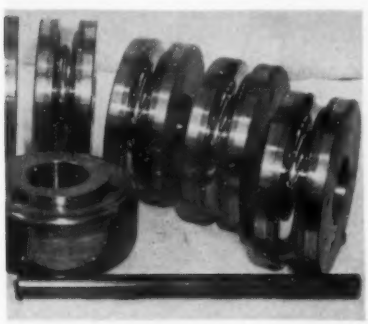
Progress in Production

CARBIDE ROLLS SIMPLIFY MAINTENANCE PROBLEMS

A replacement set of hard carbide tube-forming rolls that cost nearly two and a half times as much as previously used tool-steel rolls has resulted in significant savings in the manufacture of automotive electrical components. The set consists of rolls for six stations of a seven-station mill.

Working material is 0.875-inch-diam tubing with an 0.085-inch wall made of SAE 1010 hot-rolled steel. Produced at 30 fpm, the tubing is used for generator shafts.

The high savings resulted from differences in three major items. The quantity of tubing produced would wear out two sets of tool steel rolls. In addition, these rolls require regrinding and resetting at a cost approaching the initial costs of the two sets. The cost of 119 replacement sets of shafts and bearings formerly required is considerably more than that of the two sets of steel rolls, thus making the total cost 6½ times that of one set of steel rolls. Because the Kennametal carbide rolls require no regrinding and because only six sets of replacement shafts and bearings were required during production of the 4,680,000 ft of tubing, over-all costs were cut to less than 40 percent of former costs. A third set of steel rolls would then have been required for further production whereas the carbide rolls were good for many more miles.



Carbide inserted rolls for forming steel tubing. Workpiece (foreground) is hot-rolled steel.

SWITCH TO ALUMINUM GIVES FAST, EASY TURRET MACHINING

Turning this drum—a 5-hr lathe operation—requires 13 min as a boring operation. The work is performed on a jig mill.

What appears to be a machining operation on the barrel of a stub-nosed machine gun is actually a close-up of a fast, cost-reducing setup developed by DeVlieg Machine Co. to machine a preformed aluminum control turret used in the company's line of horizontal boring machines. The simplified machining operations involved are a result of shifting from steel tubing to extruded aluminum stock for the control sleeve part and dogs that make up the depth control turret.

Turning the drum, as shown, is done as a boring operation on a jig mill. Now completed in 13 minutes, it was formerly a 4 to 5-hr lathe operation. A combination single-point tool does the turning as well as facing and centering. Only one setup is involved since the work is turned on the table after the first end is completely machined.

Besides holding down the over-all price of the machines, redesigning the turret assembly in aluminum opens up a new area of flexibility for jig mill users. The assembly—in effect a memory element for depth control of the spindle and rapid traverse—is light enough and low enough in cost that, with spares, the multiple dogs can be set up and used for various jobs by switching drums without resetting.

THROWAWAY CUTTERS SEVER MILLING COSTS

By changing from inserted-blade cutters to throwaway milling cutters for the straddle face-milling operations on valve bodies, International Harvester Co.'s West Pullman Works of Chicago has cut machining costs by 65 percent. Previously—because roughing and finishing are done in sequence on the same machine and because the finish milling is done with inserted-blade cutters—the company used inserted-blade cutters for both operations to keep the cutter inventory low.

Using inserted-blade cutters for roughing, however, had several draw-

backs. These blades must be ground 20 times during the life of a set of blades. Each time grinding is required, the cutter has to be removed from the machine at a cost of 32 minutes in time. Most of the machine downtime was for changing and grinding roughing cutters.

With throwaway cutters, on the other hand, the expense of grinding during the roughing phase is eliminated. In addition to lower initial cost, higher load per tooth is obtained with the throwaway cutters. In contrast to the 950 parts produced between grinds with inserted-blade cutters, as many as 14,000 parts are milled before the throwaway inserts have to be replaced. Although the same 32 minutes are required to change the cutters, changing is not required as often.

The result is that the number of times the machine must be stopped is reduced. Each set of inserts produces an average of 1785 valve bodies between indexes. The Chicago company now uses Wesson Co. throwaway milling cutters for the roughing operations required on these parts. Inserted-blade cutters—also manufactured by Wesson—have been retained for finishing cuts.

SPINNING METHOD SHAPES HARD-TO-FORM MATERIALS

With the Phoenixspun method, it is possible to spin hard-to-form materials in thicknesses to ½ inch and in disk diameters to 170 inches. A high strength-to-weight ratio is achieved—on some tool steels, after heat-treating and spinning, ultimate strengths of the metal range from 280,000 to 300,000 psi at room temperature. The technique, developed by Phoenixspun Div., Phoenix Products Co. of Milwaukee, Wis., also has marked advantages in material and processing costs and delivery time.

This ⅜-inch-thick SAE 950 steel head, measuring 77 inches in diameter, was formed with the Phoenixspun process.

TOOLS of today

Lathe Runs Clockwise, Counterclockwise at All Spindle Speeds

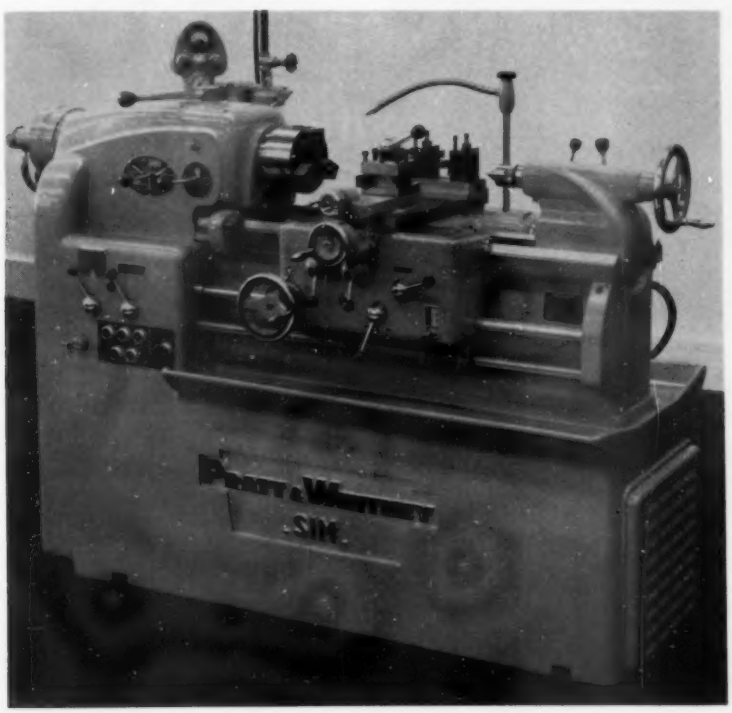
Power to remove metal at speeds to 2800 rpm is provided for the Sim lathe by a 7½-hp motor. The correct speed and feed for any type cut in any material is possible because the lathe has nine forward and reverse speeds and nine longitudinal and cross slide feeds. The desired length of cut is automatically obtained by micrometer-adjusted carriage slide stops which trip the power feed to the carriage at any desired location. Repeat diameters are picked up by selecting a preset cross slide stop. An additional feature is a built-in power meter which protects the machine from overloading and indicates dulling of the cutting tool.

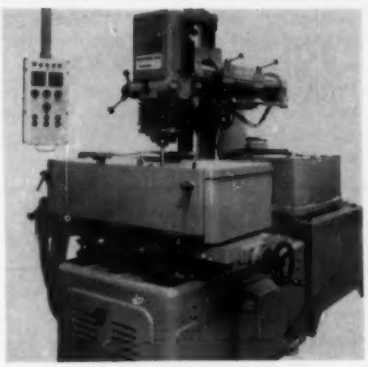
Pratt & Whitney Co., Inc., West Hartford 1, Conn. **Circle 401**

Electrical Discharge Machine for Diemaking

Workpieces as large as 42 x 19 inches can be machined by the Eleroda D-15 electrical discharge machine. Of building block construction, it removes metal at a rate of 15 cu in. an hour. Its electric impulse machining generator works from a three-phase 440/380/220 voltage supply with a maximum inlet rating of 30 kva and a mean machining current of 500 amp. The electrode is fed hydraulically with a maximum 8-inch stroke. Electrode holder-to-table distance is 29 in. maximum, 11 in. minimum. Tilt of the working head is 90 deg left, 30 deg right. Applications include die and mold work.

Charmilles Engineering Works Ltd., 25-20 43rd Ave., Long Island City 1, N. Y. **Circle 402**





Milling Unit Handles Wide Range of Parts

As many as 6000 machined parts an hour can be continuously moved beneath the milling cutter with the AutomaticMill. Eighteen holding bases of a matched set are accurate to ±0.00025 inch, allowing machining parts to be held within tolerances of 0.001 inch.

The spindle, mounted in a base with horizontal and vertical micrometer adjustments, becomes an integral part of the machine to achieve a compact milling machine requiring little floor space. The unit can also be clamped to the bed of a horizontal or vertical milling machine or to the table of a surface grinder.

The holding jaws or collets accept a wide range of parts from screw machine products to powdered metal parts. The unit is suitable for long production runs of several hundred

thousand parts while a built-in rapid traverse allows use of partial sets of tooling for the high-production machining of shorter runs of 1000 parts or less.

AutomaticMill, Inc., Danbury Industrial Park, Danbury, Conn. **Circle 403**

System Positions, Controls Work on 6-Ton Loads

This completely automatic, high-speed positioning and programming system positions and controls machine tool work on loads as heavy as 6 tons and lengths up to 150 ft. At speeds to 150 fpm, its accuracy is ½-inch over the full 150-ft length. Although the system is easily adapted to punched tape, mag-

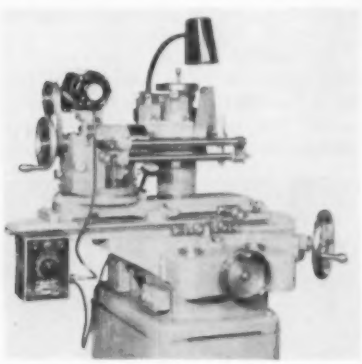
USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

netic tape or computers, punch cards are the programming medium for the standard units. A single card programs up to 60 selected positions and from 1 to 20 operations or processes at each position. The system, controlled by an electrohydraulic servo valve virtually eliminates backlash to assure close tolerance positioning for tooling operations.

Sanders Associates, Inc., 95 Canal St., Nashua, N. H. **Circle 404**

Fixture Gives Axial, Radial Relief

This relieving fixture—shown mounted on a grinder—will produce both axial and radial relief in conjunction one with the other or independent of each other. Model 2100 is adjustable, providing



varable amounts of relief. The exact amount of relief desired can be preset and measured with the dial indicators.

Henry P. Boggis Co., 706 E. 163rd St., Cleveland 10, Ohio. **Circle 405**

Optical Reader Aids Positioning, Relocating

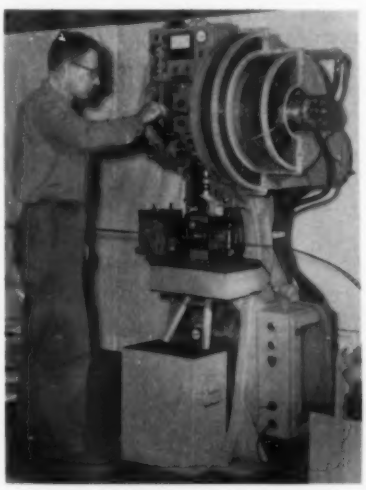
When positioning machine table or relocating workpieces, the Ever-True optical micrometric reader permits reading to 0.0001 inch. The optical unit scans SIP graduated scales attached to a machine table with an accuracy of 0.0002 inch in any 40 inches of length. They are available in one-piece lengths up to 15 ft. The reading scale can be set at any zero reference or at any starting point to eliminate additional addition or subtraction.

Edgcomb Engineering & Engraving Co., 1105 N. Hollywood Way, Burbank, Calif. **Circle 406**

Press Has Prolonged Crankshaft Life

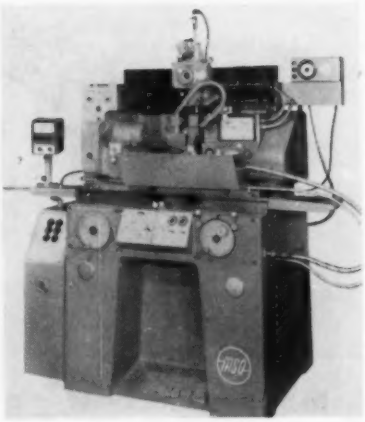
Four different stroke lengths are possible with this high-speed press. Incorporating a redesigned gap frame, it contains an air clutch mechanism that assures trouble-free operation by reducing wear on the crankshaft. The air clutch is frame-mounted. The press is available in sizes ranging from 5 to 150 tons.

Dechert Dynamics Corp., Palmyra, Pa. **Circle 407**



Cylindrical Grinder Has Servo Control

In addition to manual operation, the MSO cylindrical grinder provides automatic cycling with rapid advance of the wheelhead, rough and finish feeds at predetermined feed rates, a variable spark-out period and rapid retraction of the wheelhead. The start of the workhead and wheel spindle rotation, table traverse and coolant flow are synchronized with other machine functions. Switch-off of all components is automatic upon completion of the cycle. Capacity of Model FH-100 grinder,



available as either a plain or universal grinder, is 3½ x 12 inches. The combination of electrohydraulic servo control and magnetic valves controlled by potentiometers results in precise settings of table and wheelhead feed rates. Separate hydraulic circuits are provided for the wheelhead and table movements. Work is accurate within 0.000050 inch.

Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y. **Circle 408**

Clip Card for Control Systems

This clip card and clip card reader provide automatic control of machine tools, woodworking machinery and welding equipment at low cost. The cards are of heavy vinyl and are quickly prepared. The cards have printed graduations and can be cut with a scissors or prepared in a card punch. A series of card "fingers" are thus produced. Each finger length is in direct proportion to its command signal.

When a clip card is inserted in the reader, the fingers determine the position of the pickoffs on a series of linear potentiometers mounted on ¼-inch centers. This direct reading eliminates the need for relays or stepping switches.

The clip card can be read only when fully inserted. Pickoffs are returned to zero when a card is removed. The reader and cards are capable of more than one million readings with repeat accuracies of better than one part in a thousand. The readings of two or more fingers can be cascaded in coarse-fine control systems to provide accuracies of one part in thirty thousand or better.

Multiple component formula control is a typical application of these new components. One finger is cut for each component in a formula. When inserted, the card can produce a series of commands for scale settings in batch systems. Or it can establish the settings on a number of variable speed feeders,

Use Reader Service Card, CIRCLE 65


The story behind the chips

Savings In Time—Lower Tool Costs—Finer Finishes—More Accurate Cuts

Many types and sizes of *standard* Putnam End Mills are considered as "specials" by other manufacturers. Thus, Putnam customers get off-the-shelf deliveries that get their end mills on the job faster and at lower cost than "specials."

On the job, Putnam End Mills again save time and money. Designed for fast, free-cutting action, these end mills have extra long life. They will stand up when operated at high speeds and heavy feeds—on the toughest metals they really "hog-in" to quickly remove stock.

For applications requiring accurate cuts, Putnam's attention to manufacturing details and rigid quality control assures complete uniformity in each end mill. Also, users often find the exceptionally fine finishes obtainable with Putnam End Mills eliminate the need for grinding or hand finishing.

A pile of chips—the milling job is completed. But, for users of Putnam End Mills, there is always a story of unusual savings and benefits behind that pile of chips.

PUTNAM
TOOL COMPANY
2981 CHARLEVOIX AVE. • DETROIT 7, MICHIGAN

MILLING ALUMINUM – Putnam has a complete line of *standard* end mills that are specifically designed for efficient milling of aluminum and aluminum alloys.

ON THE BIG JOBS—Putnam Postiv-Lok will cut your costs over 25% on end mills 1½″ in diameter and larger. Quick delivery from stock on diameters to 3″.

Over 1800 Standard Types & Sizes of Putnam End Mills

Now you can order standard end mills ranging in diameter from 1/32″ to 6″ and get off-the-shelf delivery. In the Putnam line of over 1800 standard types and sizes are many end mills that are considered as "specials" by other manufacturers.

For example, in the MITEE-MITE series of standard end mills, diameters as small as 1/32″ are available. Thus, your milling, profiling, routing or engraving jobs in small or hard-to-get-at areas can now be done without special tooling.

Regardless of your requirements, there probably is a Putnam standard end mill that will exactly meet your needs. You can get all the superior Putnam cutting qualities for milling: intricate shapes, deep cuts, tough materials, aluminum, etc. – without purchasing costly specials.

Contact your local Putnam Distributor, he will recommend the best end mill for each specific job and give you quick delivery from his stock.

A plant that specializes in the manufacture of end mills

Putnam end mills are made by specialists who work in a modern plant having the finest equipment available. Every end mill is machined from high speed steels of rigid Putnam analysis, heat-treated in our own plant and produced under close quality control. Because *end mills are our business,* we carefully guard their reputation for quality and performance with individual inspection on a score of important details.

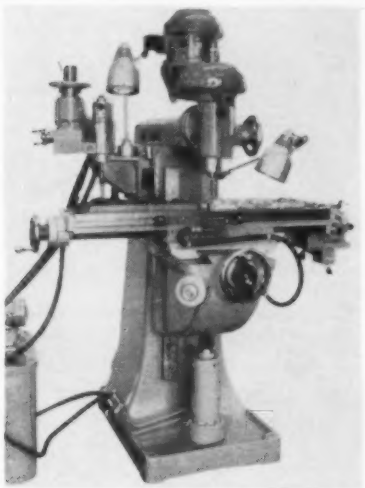
DISTRIBUTORS
IN CITIES
COAST TO COAST

gates or vibrating feeders in continuous flow systems. Proportional cutback of process rate can be had readily. Cards having up to 40 fingers will be available.

Jordon Controls, Inc., 3235 W. Hampton, Milwaukee, Wis. **Circle 409**

Vertical Mill for Hydraulic Duplicating

Hydraulic duplicating is the job of this vertical milling machine. Rather than actuating the quill, the knee is raised and lowered to follow the contours of the master. The knee cylinder is mounted in place of a vertical feed-



screw and manual vertical knee feed facilitates setup. Air hydraulic longitudinal feed to the table is available with either manual or automatic air-operated and mechanically controlled infeed. In the case of air operation, the table is fed in automatically the predetermined amount at the conclusion of each longitudinal stroke. Table sizes range from 10 x 36 to 10 x 54 inches in 6-inch increments.

U. S. Burke Machine Tool Co., Cincinnati 27, Ohio. **Circle 410**

Magnetic Tester Checks Brazed Joints

Brazed metal joints, such as honeycomb, can be checked by Recordaflux —a magnetic particle nondestructive inspection system. Its basis is a film which contains the magnetic particles. These particles detect changes from the unbrazed to brazed state and migrate to form a pattern which is revealed on the film. The fi[illegible]ts up in a few minutes after application and freezes the particles in position. After the pattern has been observed, the film can be stripped off and kept as a permanent record.

Budd Co., P. O. Box 245, Phoenixville, Pa. **Circle 4[illegible]**

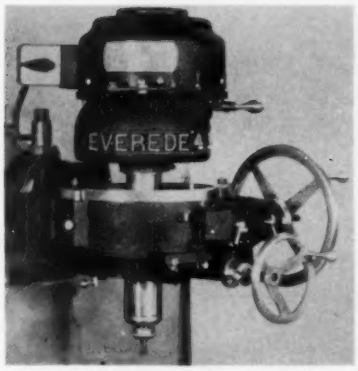
Building-Block Units for Machine Tools

New machines can be assembled, and existing machines modernized and completed, with this line of standardized Henschel subassembly units. Building block assemblies from 1 to 100 hp, with such components as spindle units, gear units, feed table units, feed gear units, adjustable slide units, round table units, bed units and drill units are available from stock. Combinations of the units can be assembled to form special machines of all types, boring and facing machines, for example, and automatic table type machines for such parts as differential housings. The units can also be used to assemble standard milling, drilling, boring, reaming, cutting, turning and facing machines.

S & S Machinery Co., 140 53rd St., Brooklyn 32, N. Y. **Circle 412**

Milling Attachment Controls Backlash

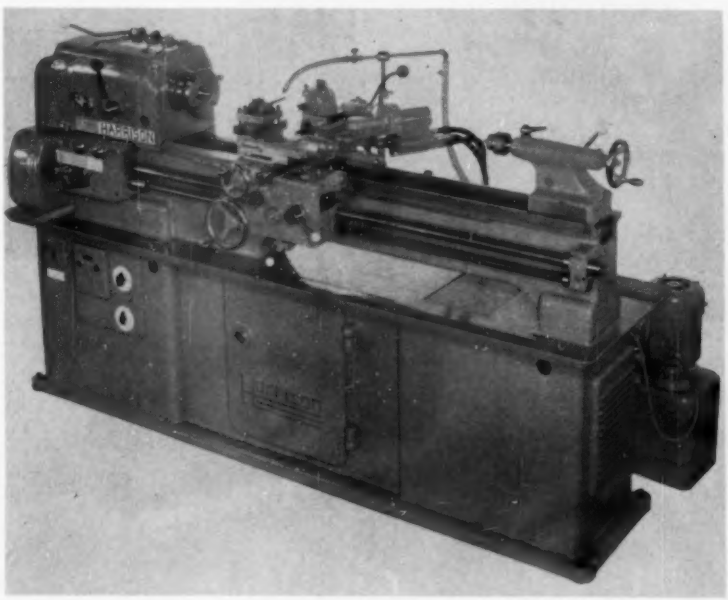
Because it has a 10-inch pitch diam wormgear and an adjustable spring loaded worm, this rotary head milling attachment—for use with horizontal or vertical milling machine—eliminates



backlash. A load lever makes it possible to produce a variable backlash between the worm and rotary wormwheel from zero, required for heavy-duty climb milling, to three minutes when using small-diameter cutters. A lock lever is used for positive locking of the rotary head at any angular position between zero and 360 deg. Powered by a ½-hp motor working either from single-phase or three-phase voltage supply, the attachment gives six spindle speeds from 310 to 4300 rpm.

Everede Tool Co., 2000 N. Parkside Ave., Chicago 39, Ill. **Circle 413**

Lathe Doubles as Toolroom and Copying Machine



This combination toolroom and copying lathe is available in two models, with either 24 or 40 inches between centers. Its tracing unit is built into the rear of the machine so that normal lathe operation is completely unrestricted at all times. Thus, it is possible to turn the required template and then lock in the copying unit for immediate quantity reproduction of the part. The machine delivers turning speeds to 2000 rpm. Its end train gearing is totally enclosed and operated in an oil bath. This not only prolongs gear life but also lowers the noise level usually associated with high-speed gearing.

REM Sales, Inc., P.O. Box 41, West Hartford, Conn. **Circle 414**

TOOLS of today

Device Doubles as Burring, Sharpening Tool

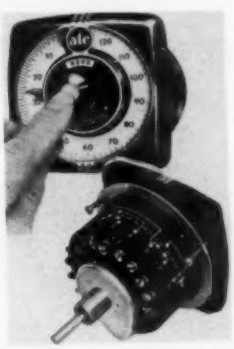
Two features of this burring and sharpening tool are carbide insert blades and a camming arrangement for advancing the edges to compensate for wear at the blade intersection. It has capacity to edge-burr sheet metal, plas-

tic or glass up to 1/16-inch wide. The cast aluminum handle is milled and counterbored to provide positive location for both blades and cam. A spring steel clamp retains and guides the insert blades.

Crodian & Co., 4897 Kessler Blvd., E. Drive, Indianapolis, Ind. **Circle 415**

Revolution Counter Has Pushbutton Control

Electrical control for machine or process equipment operation is possible with the Series 312 Atcotrol shaft-driven revolution counter. It can be directly coupled to a rotating shaft and driven at any speed, constant or variable, up to 2000 rpm with repeat count



accuracy to 0.25 percent of dial range. It is available in 11 standard dial ranges from zero to 12 to zero to 6000 revolutions. For process, batch system or automatic flow control, the counter can be wired directly to control valves, pumps, agitators and similar equipment. The shaft requires an operating drive torque of 1¼ in-oz.

Automatic Timing & Controls, Inc., King of Prussia, Pa. **Circle 416**

M1238-1818 — *Range 18" x 18", working distance 9" to infinity. Reads to 0.001" up to 24" working distance. Protractor ocular reads to 3 minutes of arc. Image is erect.*

Cut inspection time in half

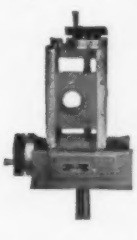
with new Gaertner Coordinate Cathetometers

These convenient, reliable optical instruments permit making precise coordinate measurements in a vertical plane. The two dimensions are measured with one setting, object does not have to be rotated. Inspection time is cut in half and resetting errors eliminated.

Versatile Gaertner Coordinate Cathetometers are ideally suited for precision measurements on large objects; also objects or points in recessed, remote, or inaccessible locations. Applications include measuring jet engine sections, complicated castings, printed circuits, bolt holes and bosses on large piece parts, traces on cathode ray tubes, etc.

Because these are optical rather than mechanical measuring instruments, you make non-destructive measurements without contact, distortion, or concern about pressure being applied to the object when making a setting. Instruments available in English or Metric system.

M1236-46— Horizontal range 6", vertical range 4". Reads to 0.0001", working distance 5" to infinity.



M1236-22— Range 2" x 2", reads to 0.0001". Working distance 5" to infinity. Shown with 19 mm mounting rod, and without telemicroscope. Instrument permits precise coordinate movement of other objects such as photo cells, probes, etc., in place of telemicroscope.

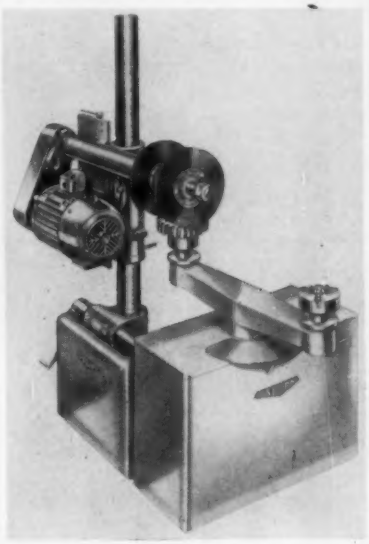
The Gaertner Scientific Corporation

1241 Wrightwood Ave., Chicago 14, Ill.
Telephone: BUckingham 1-5335

Use Reader Service Card, CIRCLE 71

Finishing Machine Has Two-Spindle Workholder

Deburring, edge blending, surface cleaning, polishing and buffing are jobs of this finishing machine. Consisting of a two-spindle indexing workholder and one finishing wheelhead, the 5224-MIA is suitable for job shop or continuous production runs. The two-spindle work-

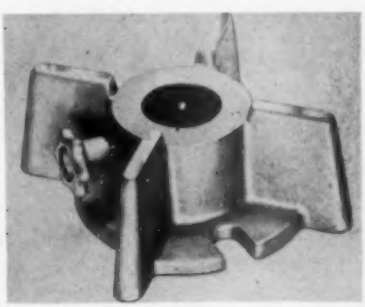


holder provides inexpensive fixturing while the finishing head is engineered for maximum versatility. Major setup adjustments are built in to achieve any compound angle for positioning the finishing wheel.

Osborn Manufacturing Co., 5401 Hamilton, Cleveland, Ohio. **Circle 417**

Punch Holder Is Self-Centering, Aligning

This unit is designed for drilling, assembling and grinding punches without removing them from the punch plate. It is self-centering and aligning. It



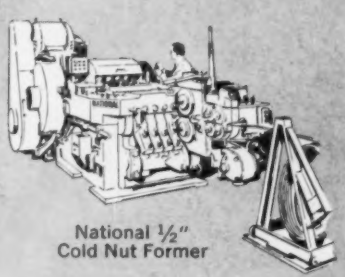
handles shanks from ¾ to 2 inches in diameter. Weighing 15 lb, it is made of semisteel casting, ground parallel to 0.0005 inch.

Montgomery & Co., Inc., 401 Morris Ave., Springfield, N. J. **Circle 418**

These unusual nut blanks are formed *automatically* — on compact, efficient National Cold Nut Formers.

Quality is excellent, scrap is low and remarkable savings are realized over other methods.

Send us your "Tough Nut Projects." Better yet, come to Tiffin where we can concentrate on *your* nut production. No obligation.



National ½" Cold Nut Former

(Available in sizes ¼" through 1")

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U.S.A.

HARTFORD DETROIT CHICAGO

Use Reader Service Card, CIRCLE 72

TOOLS of today

Air-Hydraulic Feed Units Handle Many Operations

Three quill type power feed units automatically perform machining operations such as drilling, tapping, threading and facing. Both Model 22 and 42 use compressed air for actuation and thrust power. In the first, a built-in hydraulic system provides positive action, rapid travel and feed control. A built-in cam and valve system in the second regulates the flow of air into the unit for developing an elastic or floating action rapid travel and feed movement.

Model 62 uses pressurized oil for actuation and thrust power. The flow of oil into the unit for developing high thrust positive action rapid travel and feed movements is regulated by a built-in cam and valve system. Electric motors of ½, ¾ and 1 hp are used to develop the spindle power. With a ⅜-inch-diam drill capacity in steel and 1-inch-diam in wood, and a tap capacity of 7/16-14 in steel, the unit provides spindle speeds from 400 to 8000 rpm. This range may be increased to from 4000 to 20,000 rpm with a speed increaser attachment.

Hause Machines, Inc., 809 S. Pleasant, Montpelier, Ohio. **Circle 419**

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

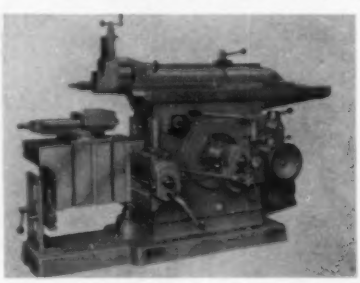
Standard Grinders Are Converted to Electrolytic

Conventional grinders can be changed to electrolyte grinding units with the Hi-Cut power converter. Available in five standard models, with capacities from 250 to 1500 amp, these converters are quickly adjusted to the job in progress and, once set, the optimum amperage output rate is automatically maintained. Thus, more than one grinder can be handled by each converter. Finishes between 5 and 12 microinches, rms, are possible and burrs or layovers are eliminated. The converter is suited for grinding carbides, honeycomb materials, stainless steels, high-temperature alloys, stellite, titanium and other exotic metals.

Hi-Carb Corp., 1055 E. 260th St., Cleveland 32, Ohio. **Circle 420**

Shaper Has Swiveling Table

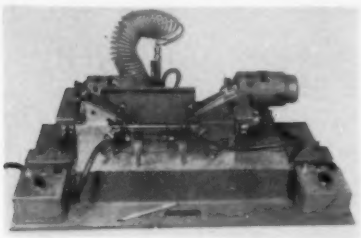
Illustrated is the Excelsior single pulley shaper Model 625. Two features of the machine are forced feed lubrication and a swiveling table. It has a 19 11/16-inch ram stroke and operates at 20, 45, 85 and 110 spm. Its 19 x 14¼-inch table has a 14¼-inch vertical adjustment and 25 5/16-inch cross adjustment.



Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y. **Circle 421**

Machine Laps Both Centers at Once

This unit—Model L-2—laps centers from 1/16 to 3/4 inches in diameter in both ends of pieces up to 7 inches long simultaneously. It contains two opposing high-speed spindles that are individually rheostat controlled to make

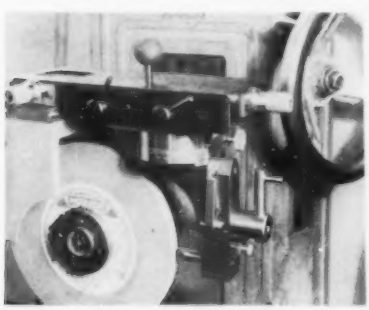


possible a small difference in the speed of the spindles which in turn produces the rotation of the parts. The workpiece is held in two adjustable V's, permitting center holes to be offset in relation to the lap. This creates a semigrinding operation.

J & S Tool Co., Inc., 87 Dorea Ave., Livingston, N. J. **Circle 422**

Dresser Maintains Wheel Position

Suitable for use with spindle housings 3 to 3½ inches in diameter, this dresser has an inverted base with compound micrometer leadscrews for main-



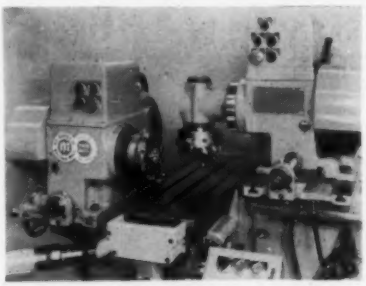
taining the position of a formed grinding wheel in relation to the work. It is adaptable to 7 or 8-inch-diam wheels and is available in sizes for most surface grinders.

J & S Tool Co., Inc., 87 Dorea Ave., Livingston, N. J. **Circle 423**

Machine Mills Two Surfaces in One Pass

Pictured is a twin mill with both horizontal and vertical milling heads, suitable for face milling two right angular surfaces at one pass of the automatic table cycle. Other features of the machine include a mist coolant system and

TOOLS of today



an air-actuated holding fixture. The machine has arbor-mounted cutting arrangements with outboard arbor support and is capable of both automatic rough and finish milling cycles.

REM Sales, Inc., West Hartford, Conn. **Circle 424**

Press Brake Control Gives Automatic Cycling

Pushbutton programming on all press brakes is possible with the Autobend control. Stepless speed control permits peaking to the maximum bending speed that the work will allow. Installation requires no major changes and the control can be attached to any size or model brake. When desired, this Model BC-100 can be controlled by two operators.

General Automation Corp., 121 Centre Ave., Secaucus, N. J. **Circle 425**

Air-Cooled Gun Welds Thin Gage Metal

Designed specifically for the gas-shielded metal arc welding of thin gage ferrous metals, the Model AS30-A gun can be used by the automotive industry and most other mild steel fabricators. It is well-suited for welding steel with the dip transfer process. Its 60-deg gooseneck design and light weight permit access to normally hard-to-get-at places and lessen operator strain from welding in difficult positions. It uses 0.035 and 0.045-inch-diam

steel wires in combination with a variety of wire feeder equipment. The manual gun is rated at 300 amp, d-c, reverse polarity.

Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y. **Circle 426**

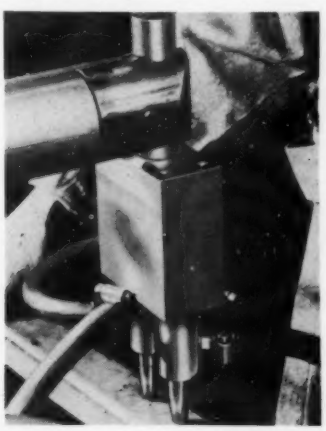
Instrument Positions, Bonds Fine Wire

Designed for use with microcircuits up to one inch square, the Model 401C positions and bonds both wire and microcomponents. It holds a basic circuit in fixed position and preheats it to a positively controlled temperature. A swingaway tray, holding a supply of components used in circuit assembly, can be positioned under the vacuum pickup when needed, or swung clear of the work area. The machine's micropositioner assemblies have positioning accuracies of 0.00001 to 0.000015 inch. A bonding tool assembly applies positively controlled pressure for thermocompression bonding.

Kulicke and Soffa Mfg. Co., Inc., Philadelphia, Pa. **Circle 427**

Electrode Holder Mounts Two Tips

The Equa-Press dual holder automatically exerts equal forging pressures through its two tip-holding barrels regardless of minor variations in work thickness or electrode wear. The equalizing mechanism is fully mechanical and provides maximum conductivity



through its working parts. The use of offset tips gives a range of distances between welds from 0 to 4 inches. Models are available for mounting in a welder arm (illustrated) or for bolting to a press welder platen. The holder has a water cooling system.

Air Reduction Sales Co., 150 E. 42nd St., New York, N. Y. **Circle 428**

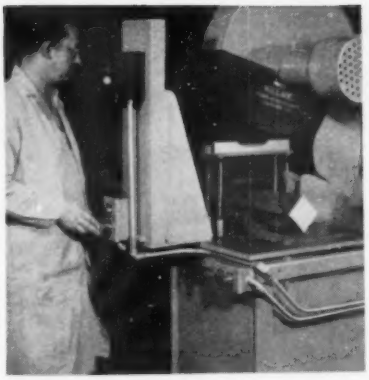
Indexing Chassis Uses Dual Motion Method

Most of the tooling on the Model SD turret indexing machine chassis is mounted on and actuated by a pair of tool plates center-mounted above the indexing turret. Moving up and down in synchronization with the main indexing cam shaft, these plates provide a dual motion method of multiple piece part assembly. Because work transfer and tool actuation are mechanically timed and interlocked, the possibility of jamming is reduced. The chassis is available in various turret diameters, index positions and work cycles.

Swanson-Erie Corp., 814 E. Eighth St., Erie, Pa. **Circle 429**

Cutting Machine Does Heavy Work

Solid rounds to 6-inch diam in most types of steel alloys can be cut with the machine illustrated at a rate of one square inch every two or three sec. Surface finishes as low as 32 microinches,

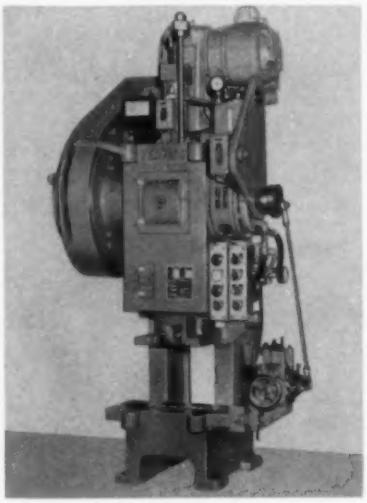


rms, are consistently obtained. The units are available with 18, 20 and 26-inch wheels. A similar series for wet cutting covers the same range of wheel sizes plus one larger size—34 inches.

Wallace Supplies Mfg. Co., 1304 W. Diversey Parkway, Chicago 14, Ill. **Circle 430**

Stamping Machines Have Vibrationless Operation

One feature of all nine models in the Series S stamping machine line is the low center-of-gravity base. This allows the press to operate at speeds to 600 rpm with virtually no vibration. Rang-



ing in capacity from 15 to 150 tons, the machines have rigid frames to insure accurate stamping and extended die life. The stroke assembly is adjustable to permit eight different stroke lengths.

Perkins Machine Co., Warren, Mass. **Circle 431**

Furnace Has Atmosphere Retort

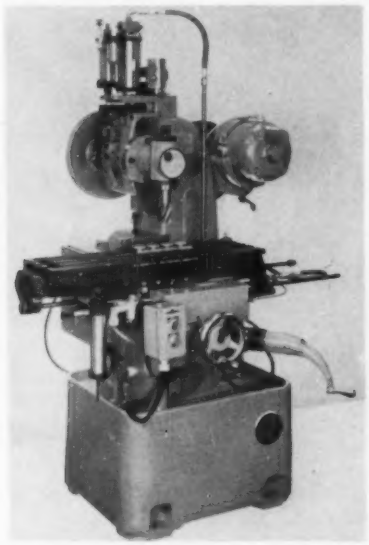
This electric crucible pot furnace with atmosphere retort and forced air cooling is well-suited for applications such as glass-to-metal sealing and heat-

treatment of metals in a protective atmosphere. The RDPC-77 furnace is rated at 2250 F maximum chamber temperature. Its chamber has a 7-inch diameter and a 7-inch depth. Atmosphere retort with a clear working area of 4½ x 6½ inches can be used to 2150 F. Rapid cooling of the retort is possible with a noninsulated forced air cooling pit.

Lindberg Engineering Co., 2450 W. Hubbard, Chicago, Ill. **Circle 432**

Miller Has Synchronized Spindle, Table Motions

Model 8SA semiautomatic production miller has both automatic rise and fall spindle cycle and table feed. It is available in two sizes with the various rise and fall spindle motions synchronized



with the table movements. Widely separated surfaces can be milled at one setting with rapid traverse between cutting positions to avoid milling air.

REM Sales, Inc., West Hartford, Conn. **Circle 433**

Magnetic Top Plate Holds Large, Small Parts

Intermediary magnetic poles that make the gap divisions finer than previously obtainable are one feature of the Ceramax chuck top plate. Holding

power for larger workpieces has been maintained by retaining the ¼-inch poles while the addition of ⅛-inch poles permits the chuck to securely hold thin workpieces as small as ⅛ inch in diameter.

O. S. Walker Co., Worcester, Mass. **Circle 434**

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

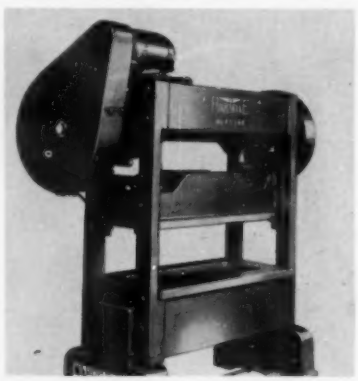
Air Clutch Mechanism Reduces Wear and Tear

Pressure on the crankshaft of an industrial press is reduced by the use of an air clutch mechanism which, at the same time, makes possible rapid engagement and disengagement without excessive wear. The clutch includes a bearing support, or quill, mounted on the frame of the press. A pneumatically triggered mechanism automatically adjusts the clutch to the effects of wear. The clutch mechanism has a 360-deg friction surface making engagement instantaneous and reducing surface heat. Backlash is eliminated. It also has a top stop button, an emergency stop button, a selector switch for inch, single or continuous strokes and two plug-in type microswitch receptacles.

Dechert Dynamics Corp., Palmyra, Pa. **Circle 435**

Press Has Adjustment-Free Clutch Operation

This 40-ton straight side Rousselle press is furnished with bed areas up to 6 ft and die spaces to 24 inches. The unit has four-corner ram support and is capable of handling rolls or sheets of

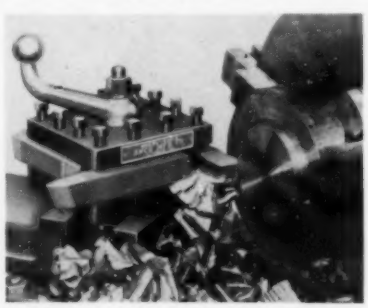


plastics, paper or sheet metal. Electrical control with either a foot or hand-operated switch permits single stroke, continuous operation or momentary inching or jogging. The press is available in 5 to 60-ton sizes.

Service Machine Co., Inc., 2310 W. 78th St., Chicago 20, Ill. **Circle 436**

Turret Toolposts Are Indexable

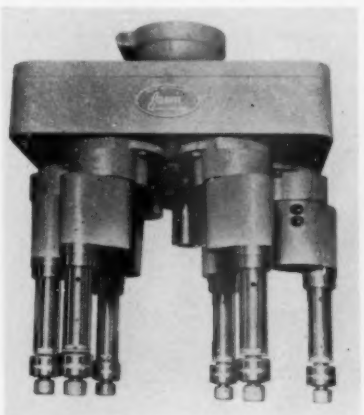
Carrying four tools, these turret toolposts have guaranteed re-indexing accuracy to 0.0005 inch at each of 12 indexing stations, which are spaced 30-deg apart. This 12-station indexing permits one tool to do the work of three tools, since each tool can be indexed to three positions. An O-ring seal keeps dust and chips from entering the in-



dexing mechanism. The turret toolposts can be used on virtually all bench lathes, engine lathes and turret lathes, and on screw machines.

Enco Manufacturing Co., 4520 W. Fullerton, Chicago, Ill. **Circle 437**

Drilling, Tapping Head Has Two to Six Spindles



This adjustable gear-driven, double eccentric drilling and tapping head is designed for use on bench type or floor model drillpresses. It is available with two to six spindles. Minimum center distance on the two-spindle head is 5/8 inch. The four-spindle unit has a 1-inch minimum center distance.

Jarvis Corp., Middletown, Conn. **Circle 438**

Fixture Grinds, Sharpens Plain Milling Cutters

This cutter grinding fixture grinds and sharpens plain milling cutters up to 6 inches in diameter on a horizontal

surface grinder. In many cases, it eliminates the need for a tool and cutter grinding machine. Its base measures 4 inches square and its over-all height is 6 inches. It weighs 5 lb.

Montgomery & Co., Inc., 401 Morris Ave., Springfield, N. J. **Circle 439**

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Plastic Face Hammers Have Lead Impact Feel

Urethane—formulated to retain its properties to –20F and to resist distorting effects of lubricating and cutting oils—is the basic material used in this screw type plastic face hammer. The hammer, offered in 1, 1½ and 2-inch-diam sizes, has an internal cavity in its aluminum or malleable iron head. The largest and the heaviest of the three models available weighs 3½ lb.

Lixie, Inc., P. O. Box 624, Providence 1, R. I. **Circle 440**

Air Chuck Permits Both Internal, External Work

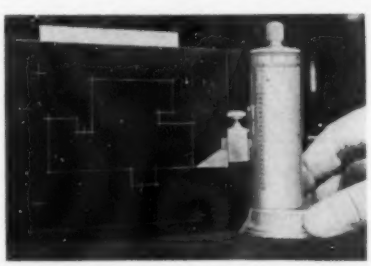
This internal and external Stace air chuck is especially useful in smaller shops where a machine tool must handle a wide range of parts. It has a built-in

cylinder, replaceable jaws and controlled clamping pressure. This chuck holds tolerances within 0.0005 TIR.

Crodian & Co., 4897 Kessler Blvd., E. Drive, Indianapolis, Ind. **Circle 441**

Instrument Voids Vernier Adding, Subtracting

Well-suited for measurement, layout and inspection jobs, this Micro-Height gage measures and scribes up to 11 inches with risers with an accuracy of ±0.0005 inch. It has two scales—one on the barrel reading in gradations of 0.100 inch and the other on the head reading



in gradations of 0.001 inch. For measuring between holes and surfaces, dial indicators are attached. Adjustments for calibration and for wear compensation are easily made on both the 2 and 4-inch sizes available.

Montgomery & Co., Inc., 401 Morris Ave., Springfield, N. J. **Circle 442**

Field Notes

SIX APPRENTICES representing five Connecticut industrial companies were judged the winners of the fifth annual metalworking trades apprenticeship competition sponsored by the Central Connecticut and Western Massachusetts Tool, Die & Precision Machining Assn., Southern Connecticut Tool & Die Manufacturing Assn., American Assn. of Tool & Machining Engineers and Manufacturers Assn. of Connecticut. The winning contestants were ROAY A. DENNIS, Pratt & Whitney Co.; KURT L. SCHUTZ, Greist Mfg. Co.; JAMES MCCULLOUGH, Chandler-Evans Corp.; JOHN M. SEVC and STEPHEN PAVLECH, JR., Singer Mfg. Co.; and NORMAN J. BELANGER, New Departure Co. They will receive outstanding apprentice awards and copies of the ASTE Tool Engineers Handbook.

new companies

A new company specializing in digital electronics has made its debut in Minneapolis, Minn. Named ADVANCED SCIENTIFIC INSTRUMENTS, INC., it will develop advanced digital and analog computing instruments and components and special-purpose electronic computing and control systems for business, industrial and military application. The firm will also provide research, design and development services on contract to industries and government agencies, and is setting up facilities to manufacture a line of custom-built computing and control instruments. Officers are Jules Ebin, board chairman; Morris B. Ebin, vice chairman and treasurer; Francis J. Alterman, president; Ralph E. Mueller, executive vice president; and Samuel H. Maslon, secretary.

TRANS-PLASTICS CORP. has been formed in Cleveland, Ohio, to provide process industries with design, development and fabrication of a corrosion-resistant systems and components made of such materials as polyvinyl chloride, polyethylene and acrylonitrile butadiene styrene. The company also introduces to industry a new line of pipe, pipe fittings, sheet and tube made of these materials. Heading the firm are Reuben Hitchcock, president, and Ted R. Stevenson, vice president.

association news

The AMERICAN HOT DIP GALVANIZERS ASSOCIATION at its recent annual meeting elected W. M. Boyles to be its president for the current year. He is president of the Boyles Galvanizing and Plating Co. of Hurst, Tex. T. R. Gregory, president of Thomas Gregory Galvanizing Works, Maspeth, N. Y., was elected 1st vice president. The office of 2nd vice president will be filled by Cooper Hawthorne, vice president and general manager of Metal Services, Inc., Port Neches, Tex. Charles E. Perry and John R. Daesen will serve as secretary-treasurer and technical director, respectively.

Twenty-five years of scientific research for industry and government was recently celebrated by ARMOUR RESEARCH FOUNDATION OF ILLINOIS INSTITUTE OF TECHNOLOGY. From a modest beginning in a few basement rooms in 1936, the foundation has grown to a seven-building complex. Research volume for the fiscal year ending last August totaled $16,500,000. The silver anniversary celebration will include dedication of a new chemistry research building and a mechanics research building extension.

expansions

AUSTIN CO., international engineering and construction firm with general offices in Cleveland, Ohio, has announced the formation of two new firms in Australia and Argentina through which it will provide American companies interested in those countries with design, engineering, construction and consulting services. The new firms are jointly owned by Austin and Australian and Argentinian engineering-building organizations whose familiarity with local conditions will supplement the experience of Austin executives and engineers who have been permanently assigned to those countries.

Licenses have been granted by H-P-M DIV., KOEHRING CO., Mount Gilead, Ohio, to manufacture its line of Cast-Master die casting machines in England and Australia. CRAVENS, LTD., will manufacture these machines at its plant in Sheffield, England, and JOHNS HYDRAULICS, LTD., in Victoria, Australia. Both of these companies were granted licenses several years ago to manufacture H-P-M hydraulic presses for metalworking and process applications, and H-P-M plastics molding machines.

Consolidation and expansion of operations in Canada under a new subsidiary have been announced by BURROUGHS CORP. President of the subsidiary is Joseph L. Rapmund who has been for 25 years general manager of Burroughs marketing operations in Canada.

moves

CARBORUNDUM CO. and its subsidiary, PACIFIC ABRASIVE SUPPLY CO., which formerly operated separate office and warehouse facilities in the Los Angeles area, have moved their offices and stocks to a $1,500,000 abrasive service center at 2240 S. Yates Ave., Los Angeles, Calif. The center is comprised of three service departments—the grinding wheel department, abrasive belt and machine department and barrel finishing department. Heading Pacific Abrasive Supply is Harry Bayley, vice president and general manager.

CONFORMING MATRIX CORP., originators and manufacturers of electroformed metal masks and producers of clamps and pressure fixtures, mask washing machines and automatic machines for precision spray decorating and protection coating, has just moved into its new plant at 830 New York Ave., Toledo 11, Ohio. The quarters occupy 22,500 sq ft of floor space.

new activities

NORTON CO.'s machine tool division has purchased the rights to, and will begin manufacturing, two new machines used in the wafering and lapping of semiconductor materials used in solid state electronic devices such as transistors. The Multi-Blade wafering machine is designed to cut approximately 300 wafers 0.010 inch thick from a single ingot in one operation. The Four-Way lapping machine produces wafers as thin as 0.006 inch lapped to extremely close tolerances of thickness and parallelism.

BORG-WARNER CORP., Chicago, Ill.; DEL E. WEBB CORP., Phoenix, Ariz.; HALLICRAFTERS CO., Chicago; NEWBERY ELECTRIC CORP., Los Angeles, Calif.; and SCOTT CO., Oakland, Calif., have formed a Missile Facilities Activation and Maintenance task group. The purpose of the group is to provide management and technical support for the ac-

tivation and maintenance of missile bases and launching facilities for operational Atlas, Titan and Minute Man intercontinental ballistic missiles.

MINIATURE PRECISION BEARINGS, INC., announced the formation of a division to produce and market a line of low-cost miniature ball bearings. The new unit of the Keene, N. H., firm will be called MINA BEARINGS, A DIVISION OF MPB, INC. In making the announcement, MPB's executive vice president, William M. Scranton, said, "the MINA Bearing Div. has been established to broaden the market base for the products of MPB and its divisions, particularly in nonmilitary markets where cost is the primary factor and precision and performance is less critical."

name changes

Approval of a plan to change the name of THE ARO EQUIPMENT CORP. to THE ARO CORP. has been voted by the shareholders. The new name will identify the company more clearly and signify the fact of its expansion into a wider range of products and markets.

awards

JULIUS HEUSCHKEL, consulting welding engineer at the Westinghouse Electric Corp. research laboratories, Pittsburgh, Pa., has been awarded the 1960 James F. Lincoln Gold Medal by the AMERICAN WELDING SOCIETY. The award was made for the greatest original contribution to the advancement and use of welding reported in the society's journal during 1960. Entitled "Weld Metals in Nickel-Base Alloys," his paper reports the results of a series of experiments conducted on the composition, tensile properties, microstructure and hardness of several nickel-base weld metals and the effect of temperature on these properties.

ROLAND P. KOEHRING has been named a powder metallurgy pioneer by the METAL POWDER INDUSTRIES FEDERATION as a tribute to his 40 years of effort in the industry. The recognition was for advancing powder metallurgy from a laboratory technique to an industrial technique. During his career, Koehring has been associated with the development of the continuous controlled atmosphere method of sintering, the perfection of numerous powder metallurgy compositions and processes, several automobile engine bearing materials,

sintered metal filters and metallic friction materials. He was also instrumental in the adoption of standards and materials specifications for powder metallurgy products.

Five men widely known in engineering and industry were cited for outstanding accomplishments in their fields at the 13th annual Wisconsin Engineers' Day celebration. Among them were JOHN J. CHYLE, director of welding research for A. O. Smith Corp., Milwaukee, Wis.; WILLIAM T. ENNOR, assistant director of research, Aluminum Co. of America, New Kensington, Pa.; MERRILL A. SCHEIL, director of metallurgical research, A. O. Smith Corp.; and FREDERICK M. YOUNG, founder of the Young Radiator Co., Racine, Wis.

mergers

FEDERAL MACHINE AND WELDER CO., Warren, Ohio, is to be completely merged with its parent company, McKAY MACHINE CO., of Youngstown. The Warren firm, a subsidiary of McKay since November 1960, will be known as FEDERAL-WARCO DIV. OF McKAY MACHINE CO. It will retain its present management, personnel and facilities.

acquisitions

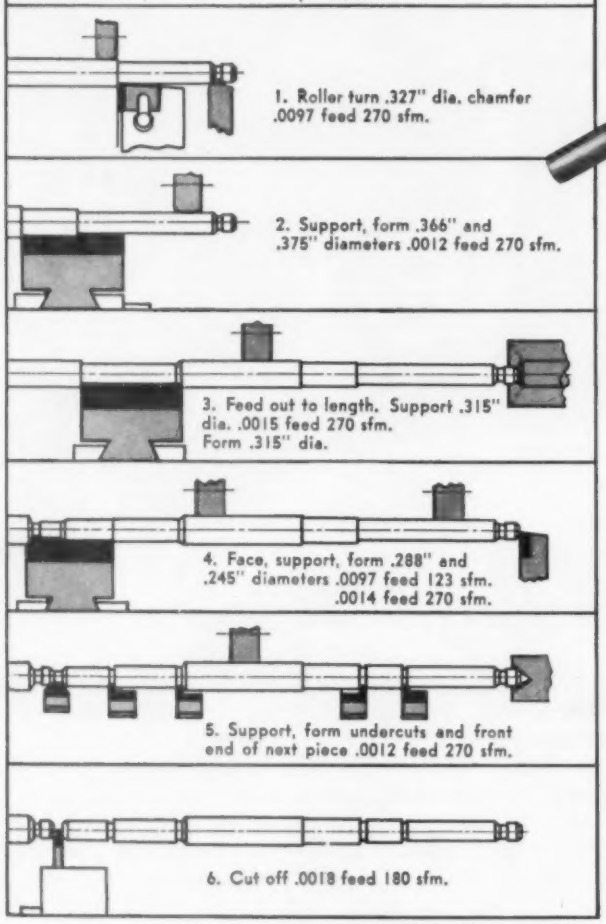
C. N. Johns, president of AMERICAN CHAIN & CABLE CO., INC., has announced the purchase of all capital stock of BANCROFT-HICKEY MFG. CO., Bristol, Pa. Bancroft-Hickey company will continue to manufacture grinding wheels and other abrasive products at its present plant.

UNIVERSAL VISE AND TOOL CO., Parma, Mich., announces the acquisition of the standard pump jig and fixture lock product line of SWARTZ TOOL PRODUCTS CO., Detroit. Swartz will continue to manufacture special tooling and fixturing in Detroit. Universal Vise and Tool will manufacture and market the Swartz line from its plant at Parma under a new division to be known as Swartz Standard Fixture Div.

FANSTEEL METALLURGICAL CORP., North Chicago, Ill., has contracted to acquire WESSON TOOL CO., Detroit, Mich. The Wesson complex includes Wesson Multicut Corp., Wesson Metal Corp., including Archer & Smith Div., and Wesson Co. as subsidiaries. In addition, Fansteel is acquiring the controlling stock interest in the Canadian subsidiary, Wesson Cutting Tools, Ltd. Wesson plants are located at Lexington, Ky., and Brighton and Ferndale, Mich.

GREENLEE AIR-FEED AUTOMATICS BENEFIT "ELECTROLUX" FOUR WAYS . . .

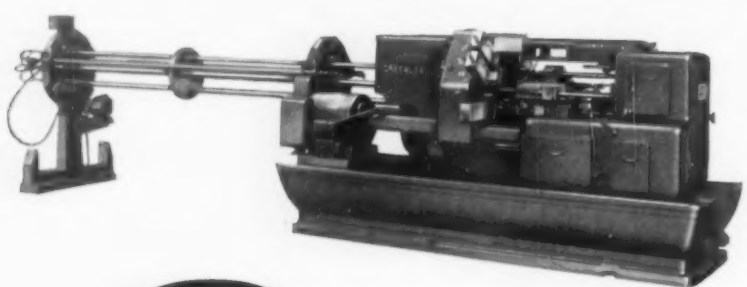
MACHINE . . . 1"-6 Automatic Bar Machine Air-Feed — Feedout on index and in 3rd position during machine cycle. TOOLING . . . Carbide Tipped MATERIAL . . . 1137 STOCK SIZE . . . 13/32" rd.	TOOL SLIDE STROKE . . 1-9/16" at .0097" feed. SPINDLE SPEED . . . 2540 rpm 270 sfm. MACHINE TIME . . . 5.8 seconds. ESTIMATED GROSS PRODUCTION . . . 620 per hour



1. Eliminate stock pushers . . .
2. Eliminate scoring of stock . . .
3. Reduce downtime during set-up . . .
4. Provide extra length feed-out . . .

The part is a 6-7/8" long armature shaft used in the "Electrolux" vacuum cleaner. It demonstrates how effectively Greenlee Air-Feed Automatics and carbide tooling can team-up to increase production and reduce costs. The shaft is machined from 13/32" S.A.E. 1137 steel at a gross production rate of 620 pieces per hour. Recommended cutting speed for high speed tooling is 120 sfm. The rate was boosted to 270 sfm with carbide-tipped tooling. Sequence of operations is shown at the left.

Note how the stock is partially fed out on the index and to its full length in the third position. This provides for the most effective tooling arrangement. Greenlee Air-Feed Automatics permit greater job versatility and assure added profits. See your Greenlee representative or send us a print of your high-cost problem-part.



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Trade Literature

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"This is glass"—a comprehensive story of glass and glass ceramics—reviews the history of glass and details the basic types. It also describes the expanding role of glass in science, industry, electronics and lighting. Corning Glass Works. **(Circle 501)** . . . Suggested specifications and hints on proper selection for specific applications are included in a bulletin about cut-off wheels. Simonds-Worden-White Co. **(Circle 502)** . . . A handbook shows how a pulling system solves everyday pulling and installation problems. Owatonna Tool Co. **(Circle 503)** . . . A catalog contains 64 pages describing compressed air line filters, pressure regulators, air line lubricators, valves and other miscellaneous products. C. A. Norgren Co. **(Circle 504)** . . . Basic information concerning helical springs, flat springs, wire forms, special fasteners, metal stampings and assembled springlike devices is included in a 16-page manual. Associated Spring Corp. **(Circle 505)** . . . Three standard grades of high-speed toolbits are covered in a catalog with typical analyses, recommended uses and sizes. Firth Sterling, Inc. **(Circle 506)** . . . A method for quick identification of mounting accessories for square type, industrial hydraulic and pneumatic power cylinders is presented in a reference bulletin. Hannifin Co. **(Circle 507)** . . . Advantages of an adjustable safety positioner include the elimination of accident potential and the reduction of power press downtime. Duff-Norton Co. **(Circle 508)** . . . Designed to effectively isolate shock and noise, the leveling machine mounts discussed in a 4-page bulletin dampen 85 percent or more of the machine vibration. Clark-Cutler-McDermott Co. **(Circle 509)** . . . A new approach to valve design has been originated to solve the problems of valve wear and maintenance in controlling abrasive or corrosive fluids and gases. Airmatic Valve, Inc. **(Circle 510)**

Automation, Mechanization

Advanced mathematical techniques and a high-speed computing system team up to reduce overhead costs, excess inventories and production waste for manufacturing concerns. The computing system uses multiple regression analysis and linear programming to provide manufacturing management with timely data for improved control and decision making. The report is entitled "A Solution to the Profit Squeeze." Bendix Computer Div. **(Circle 511)** . . . How drive speeds of machines and processes can be automatically controlled and regulated by simple pneumatic instrumentation is the subject of a bulletin on a versatile automation system. Reliance Electric and Engrg. Co. **(Circle 512)**

Cutting Tools

A bulletin illustrates and lists a series of end mills, drills, spiral flute drills, reamers, ground cutters and uniflute countersinks in both carbide and high-speed steel. M. A. Ford Mfg. Co., Inc. **(Circle 513)** . . . High-speed cutting tools including taper, ball nose taper, multistep, shell, expansion, line and half-line reamers are portrayed in a brochure. Also illustrated are keyway, interlocking milling and ball nose rose cutters. Special Cutter and Tool Co. **(Circle 514)**

Boring, Drilling, Tapping

A general catalog, containing approximately 150 pages, gives information about toolholders and milling machine arbors and adaptors. Drawings accompany the items included. Beaver Tool and Engrg. Corp. **(Circle 515)** . . . This catalog describes in detail a line of machines for automatic machining such as drilling and tapping, reaming and C-boring, milling and facing, trepanning and outside threading. Several applications discussed explain how quality standards may be improved and labor costs reduced using simple tools and unskilled operators. Globe Tapping Machine Co. **(Circle 516)** . . . Features of a new table type horizontal boring mill are summarized in this bulletin. Details described include specifications, two types of pendant controls, automatic positioning, tracer controls, numerical controls and accessory equipment. Cincinnati Gilbert Machine Tool Co. **(Circle 517)** . . . Keyways up to 1¼ inches wide and 9 inches long can be produced by an automatic feed keyseater. Star Cutter Co. **(Circle 518)** . . . A catalog covers portable, precision grinding tools and small hole drilling equipment. Dumore Co. **(Circle 519)** . . . A new toolmakers' sine is specifically designed to reduce setup time and insure accuracy for the angular milling, grinding and boring of round stock. Production Tool and Die Co. **(Circle 520)**

Cleaning, Painting, Plating

A self-turning, transistorized 20-kc line of ultrasonic cleaners has selectable power levels, automatic compensation for load and liquid levels and high overall efficiencies in the order of 80 percent. Acoustics Associates, Inc. **(Circle 521)** . . . Nineteen plating and other metal-finishing processes and procedures are described in a 24-page bulletin. Solution preparation, type of deposits, operating conditions, equipment required and applications are listed for each of the proceses. Hanson-Van Winkle-Munning Co. **(Circle 522)** . . . Electromechanical rotary vibrators are totally enclosed, dust-tight and water-tight and are grease lubricated through easily accessible fittings. Syntron Co. **(Circle 523)**

Fastening, Joining

How a setscrew works and why it often doesn't are told in a bulletin. Standard Pressed Steel Co. **(Circle 524)** . . . A self-contained, portable, bench type punch and die sharpener has a built-in fixture to provide convenient and economical method of sharpening. Punch Products Corp. **(Circle 525)**

Finishing, Grinding

A brochure, outlining a line of vertical spindle surface grinding wheels and segments, describes the various segment shapes, bonds and abrasives, together with their work applications and exclusive advantages. American Emery Wheel Works. **(Circle 526)** . . . A reciprocating hand machine performs jobs such as filing, lapping, honing, polishing, scraping and sawing. Hyprez

Trade Literature

Div., Engis Equipment Co. **(Circle 527)** . . . Features of a die grinder include a newly designed, adjustable speed motor that develops unusually high horsepower. The tool accepts heavy-duty carbide burrs with either ⅜-inch or ¼-inch shanks. Cleco Air Tools. **(Circle 528)** . . . One feature of a 7-inch grinder is its twin light safety shield which contains double strength, shatterproof glass. Inside the shields, bayonet type bulbs are shaded to prevent glare while illuminating the face and both sides of the wheel. Rockwell Mfg. Co. **(Circle 529)** . . . Included in a 4-page folder on a double-end internal grinder are detailed descriptions of machine movements, a schematic close-up of tooling area and complete operating specifications. The machine was designed for grinding both a straight and a tapered bore at a single chucking. Bryant Chucking Grinder Co. **(Circle 530)**

Gearmaking

A selector data sheet illustrates typical gears and splines and shows the best processing method for each, depending on high, medium or low production requirements. Also pictured are 26 basic types of gear cutting, grinding and finishing machines, gear-checking equipment and gear cutters. Michigan Tool Co. **(Circle 531)**

Heat-Treating

Seventeen models in a line of modernized mesh belt furnaces for continuous brazing, annealing and sintering operations include electric and gas-fired units with heating chamber lengths from 3 to 11 ft. Harper Electric Furnace Corp. **(Circle 532)**

Inspection, Measurement

This 32-page catalog of air gages helps in selecting gages for all requirements ranging from manual gaging to the most complex post-process, in-process and automatic applications. It also provides the gage engineer with basic design data. Standard Gage Co. **(Circle 533)** . . . Scientific instrumentation including constant temperature equipment; chemical-biochemical instruments; materials-testing apparatus; regulating devices; superpressure equipment and hygrometric instrumentation is given extensive coverage in a 67-page catalog. Hygrodynamics, Inc. **(Circle 534)** . . . Measuring and recording roundness, flatness, roughness, waviness, scratches, flaws and total surface profiles are described in detail in an 8-page brochure. Mircometrical Mfg. Co. **(Circle 535)** . . . A line of scales and weighing equipment uses a projected shadow image of a light as the weight indicator rather than a mechanical pointer or other type of dial indicator. For repetitive weighing, these scales have predetermined weight scales with a 1:1 ratio even balance lever to provide high sensitivity. Exact Weight Scale Co. **(Circle 536)**

Materials

A brochure entitled "Ductile Vanadium: Techniques That make Fabrication Easier" discusses new fabricating techniques for hot worked and cold worked ductile vanadium. Vanadium Corp. of America. **(Circle 537)** . . . An engineering data sheet covering a cement for powdered brazing filler metal presents application procedures and a typical case history application. Wall Colmonoy Corp. **(Circle 538)** . . . An 8-page engineering guide on carbon-graphite materials for mechanical applications such as bearings, bushings and seals presents grade recommendations and lists properties for each. National Carbon Co. **(Circle 539)**

Milling

Two independent overhead spindles perform the same variety of operations, differing only in the method of spindle-speed selection. The smaller unit uses hand cranks and the larger model uses pendant dial selection. Cincinnati Milling Machine Co. **(Circle 540)** . . .

Whether to mill with conventional cutters or throwaways is the question of an 8-page discussion of all the factors that influence selection. Wesson Co. **(Circle 541)**

Electric Motors, Controls, Drives

A bulletin gives data for remote indication and remote control, listing several of the indicator arrangements available. It also describes use of cam-operated limit switch as an automatic feedback control and gives specification tables for customer use when selecting dial type, degree of accuracy and appropriate indicators and transmitters. General Electric Co. **(Circle 542)** . . . Both a motor and a solenoid, a torque motor can be used for operating brakes, cams in conjunction with mechanical linkages, clamping mechanisms, clutches, elevator door openers, jigs and fixtures, reeling, slack take-up in winding and tensioning devices. Ohio Electric Mfg. Co. **(Circle 543)** . . . Highly repetitive operations in limited space industrial applications can be aided by a snap-action limit switch. It is available in button operated, plunger operated and roller-lever operated forms. General Electric Co. **Circle 544)** . . . A complete line of a-c motors includes models with ratings from 1 to 2000 hp. Reliance Electric and Engrg. Co. **(Circle 545)**

Pressworking

A bulletin on high-speed drillpresses covers their use for printed circuit work, instrument manufacturing and secondary screw machine operations. Electro-Mechano Co. **Circle 546)**

Punches, Dies

Descriptions of numerous progressive rotor-stator dies, full pierce rotor-stator dies, synchro motor dies, progressive E & I and ballast dies, thick material dies, special shape and form dies and carbide slot or index dies are given in a 52-page booklet. Also included are easy-to-read charts on carbide selection, carbide characteristics and calculation formulas on blanking and stripping pressures. Oberg Mfg. Co., Inc. **(Circle 547)**

Welding, Soldering, Brazing

A revised and expanded manual discusses brazing procedures, problems and solutions. Advantages and applications for a line of silver brazing alloys —from those in standard rod forms to a new alloy which incorporates the fluxing agent in the center of the wire —are pointed out. Easy-to-read diagrams are included to aid in selecting the proper alloy. Air Reduction Sales Co. **(Circle 548)** . . . Section 8 of the "Positioneering" course by Charles N. Aronson discusses welding positioners, the many features that are necessary and how these features work for the users' benefit. Specifications on 1000 to 24,000-lb-capacity models are also given. Aronson Machine Co. **(Circle 549)** . . . A solder foil has a minimum thickness of 0.0005 inch and a maximum width of 6.00 inches with tolerances of thickness held to ∓0.0001 inch. Accurate Specialties Co., Inc. **(Circle 550)** . . . A series of reference data charts pertaining to a complete line of bronze welding electrodes, bare filler rods and wire gives information on comparative bronze electrodes, melting rates and efficiencies, electrode and filler rod specifications and recommended welding currents for various welding procedures. Ampco Metal, Inc. **(Circle 551)**

Workholders, Fixtures

Elements of a quick-change tooling system for reducing machine tool downtime and increasing individual operator output are covered in a brochure. DeVlieg Microbore Div. **(Circle 552)** . . . A 12-page catalog contains complete information and drawings of more than 1000 clamp assembly and fixture components. Accurate Bushing Co. **(Circle 553)** . . . A bulletin covers stationary dieheads and throwaway insert chasers for use on turret lathes, hand screw machines and other applications where the diehead does not rotate. Eastern Machine Screw Corp. **(Circle 554)**

.....readers' viewpoints

. . . education

To the Editor:

I find it very encouraging to read articles such as Dr. Drought's in THE TOOL AND MANUFACTURING ENGINEER. (The role of Science in American Manufacturing Progress, April 1961.)

Dr. Drought opines that the first chair in machine tools was established in Germany in the second decade of this century. Actually, it was established in 1904 at Berlin Technical University by Professor George Schlesinger.

The establishment of a chair in metal-cutting science did not take place until 1927. In this, Berlin Technical University was also first . . . The writer of this letter established the chair at Berlin and held it from 1927 until 1934.

It should be pointed out that this department was a direct result of my interest in the work of F. W. Taylor. His book *The Art of Cutting Metal* was the first step toward scientific utilization of machine tools.

Interest in this department was great from the time of its inception. In addition to students at the under-graduate level, we had many graduate engineers, both German and foreign, in attendance.

Because departments of this type serve such a useful purpose, I find it difficult to understand the slowness of American universities in adapting them to their curriculums.

Dr. Max Kronenberg
Consulting Engineer
Cincinnati, Ohio

. . . punch wear

To the Editor:

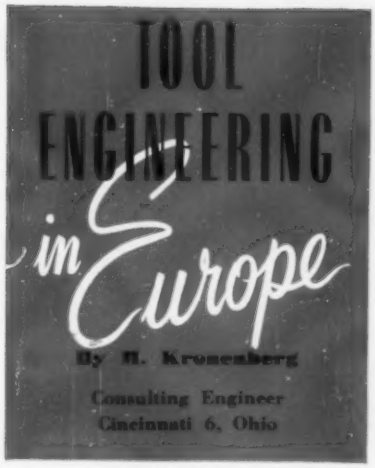
In the April issue of THE TOOL AND MANUFACTURING ENGINEER, it is noted (p. 153) that punches with high chromium content show excessive wear when piercing stainless steel. This phenomenon is attributed to the affinity of the punch and workpiece material.

I've personally experienced this difficulty in perforating small-diameter holes in full-hard stainless steel. As yet, however, the best punch material I've found is HCHC tool steel.

I'm now wondering whether the editors of THE TOOL AND MANUFACTURING ENGINEER may have some additional information on methods of prolonging punch life when piercing stainless steel.

Name Withheld

According to the 8th edition of the *Metals Handbook*, carbide offers the greatest punch life when perforating stainless steels of any type. —Ed.



Hobbing Machines

Three new methods for dynamic testing of the accuracy of hobbing machines are covered in the article: "Dynamische Drehfehler Untersuchungen an Waelzfraesmaschinen und ihr Einfluss auf die Genauigkeit gefraester Grossgetriebe-raeder," which appears in *Zeitschrift des Vereins Deutscher Ingenieure*, Vol. 103, No. 6, 1961, p. 240-247.

The methods were developed in three different countries. In a method developed in Czechoslovakia, magnetic measuring disks are used to reduce the effects of the hobbing machine gear drive on the accuracy of the produced gear. Another method, developed in Great Britain, utilizes optical effects. The third method, developed in Germany, utilizes a seismic measuring device.

Two magnetic disks are attached to the machine in the magnetic method. They run at an angle of 90 deg to each other. Magnetic waves are transcribed on the disks before testing, at a ratio equal to the number of teeth of the worm gear to the pitch of the worm. The relative phase difference does not change when the gear drive is in perfect condition, while an error in the gears is recorded on a graph. Measuring accuracy is one second of arc. In the British method, use is made of the Moiré fringe phenomenon. These fringes appear when two plates with very fine hairlines are moved with respect to each other. Light from an outside source changes in intensity with the overlapping (or nonoverlapping) of the hairlines and is recorded by means of photoelectric cells. These plates are attached to the machine in the same way as the magnetic disks.

It is claimed that the seismic method is considerably more accurate than the two other methods, attaining an accuracy of 0.05 second of arc. Two seismic masses are used, one attached to the main spindle, the other to the worm gear. In the case of a manufacturing error, say in the pitch of the worm gear, the gear would not rotate uniformly, while the mass would not be affected by the error. The difference in motion can be measured electronically and recorded on a graph. The seismic method can be used when the machine is in production.

Testing of Grinding Wheels

A paper by J. Peklenik published in *Microtecnic*, Vol. 14, No. 5, 1960, p. 233-238, attempts to define the grade of grinding wheels by means of a measurable, physical quantity, taking its statistical distribution into consideration. In order to solve these problems a new measuring device was developed. It is claimed that the evaluation of the test results and their physical interpretation made it possible to establish the grinding wheel grade and also showed the theoretical and practical significance of the problem. A diamond chisel is used for measuring the wheel grade and establishing a relationship with the Norton scale.

Tape Standards

Since the last time tape standards were discussed in this column (March 1961) tentative German standards have been published. These are of great interest to the American machine tool industry because they could affect the export of American-made machine tools with numerical control.

W. Simon, who is chairman of the German standards committee on punched tape, has written an article on tape standardization that appears in *Werkstattstechnik*, Vol. 51, No. 3, 1961, p. 124-126. In the article which is entitled, "Informationstrager und Propgrammschrift", Simons points out that great confusion exists in the United States because the programming of a milling machine produced by company "X" is different from that of a milling machine produced by company "Y." He recommends that such a condition be avoided in Germany.

Simon recommends using the five-channel tape, rather than the eight-channel tape standardized in the United States, stating that a five-channel coding system costs one-third the cost of an eight-channel system. The five-channel system should also be preferred in Germany because it can be tied to the teletype tape and because repair parts are available for punching teletype tapes. In addition, the author notes that both England and Russia are using the five-channel tape.

In some respects, however, the author appears not to be sufficiently aware of the disadvantages of five-channel tape. The eight-channel system permits 255 punch combinations, for example, as compared to 31 for the five-channel system. He also calls for the development of an automatic method for checking the correctness of the punched tape, a requirement that is satisfied in the United States when using devices such as the Flexowriter and others.

The tentative standard—No. VDI 3259—is reproduced in the article. Most of the standard deals with recommendations for the five-channel tape. There is also some coverage of eight-channel tape.

Piezoelectric Dynamometer

The principle of piezoelectricity, which was discovered in 1884 by Curie, has been used in a dynamometer to measure cutting forces. This is described by E. Bickel in a publication of the International Research Organization for production Techniques, Vol. 14, No. 5, 1960. The title: "Die Problematik der Messung von wechselnden Kraeften an der Werkzeugschneide."

All types of cutting force dynamometers employ the deflection of a member for measuring forces and vibration, despite the fact that this design prevents high rigidity. At the Engineering College of Switzerland, Bickel and his assistant, Fischer, have developed a dynamometer that incorporates quartz crystals that generate an electric current when a force is applied to them. Although this principle is not new, it appears that Bickel and Fischer have been able to separate vibration force from the mean cutting force. Oscillations due to motion have been confused with cutting force pulsations in the past. For this reason the author is critical of the available data on the measurement of vibration.

Self-induced vibrations can be separated from the pulsating cutting forces when using the piezoelectric principle, making it possible to gain new information on chip formation, vibration of machine tools, tool life, etc. Considerable practical difficulties, such as insulation and stabilizing of the amplifier at low input voltage, exist with this type of dynamometer. Several oscillograms published with the article indicate that the pulsation of the cutting force is often due to changes in the friction force at the tool face and that the radial force component in turning operations increases sharply at the instant of chatter.

Gear Shaving Analysis

When shaving small diameter gears that have a large helix angle, the tool life of the shaver can be increased threefold and more by periodically shifting the so-called "intersection point." This is one of the results of

a mathematical analysis by V. D. Klepikov. An article by Klepikov appears in *Stanki i Instrument*, No. 10, 1960. The article is translated into English in *Machines and Tooling*, Vol. 31, No. 10, 1960, p. 19-22. The title is "Increasing the Effectiveness of Gear Shaving."

The author points out that, in order to increase efficiency, the cutting edges of a shaving tool should be periodically or continuously traversed along the width of the face of the tooth so that all cutting edges participate fully in the machining process. He discusses in detail the position of the contact area of shaver and gear tooth, describing the participation of the cutting edges when the intersection point of the axes is at a constant position and also when the intersection point is shifted periodically. The analysis includes the determination of the tangents of the shaver and gear teeth at predetermined distances from the pitch line and also the derivation of formulas for the involute radii in a plane tangential to the base circle.

In addition to the mathematical analysis, the author has run tests to determine certain constants included in his equations. As an example he found that a factor K, which takes into account the lack of cutting action by separate shaver edges equals 0.6, indicating that only 60% of the cutting edges are effective in common practice. Formulas are presented for the minimum backlash between gear and shaver teeth, both in the face section of the shaver teeth and in the gear face section.

If the productivity of a shaving process is to be increased (instead of the tool life) the maximum depth of cut must be calculated first. Maximum productivity will be obtained by machining in one roughing and one finishing stroke.

Milling Turbine Buckets

Tool geometry for machining turbine buckets has been investigated by B. Meier of Switzerland. His analysis was made to determine the conditions that would cause interference between a milling cutter or grinding wheel and a tapered surface located inside a workpiece, such as the Christmas Tree in a turbine bucket. The methods used in the investigation and the results obtained are described in *Werkstatt und Betrieb*, Vol. 94, No. 2, 1961, p. 90-91. The article is entitled "Bearbeiten von Innenkegeln."

Starting with a simple case—machining internal tapers with cutters of

various sizes where interference, and thus distortion of the produced surface, does not occur—the author proceeds to a study of cases where distortion does occur. Using a graphical method that involves projecting the cutter as a circle onto a hyperbolic, parabolic or elliptic section through the produced surface, the author shows that interference does not occur whenever the radius of curvature of the section through the produced surface at the point of contact with the milling cutter is larger than the cutter radius. This may sound complicated, but the reasoning is not hard to follow when the illustrations included with the article are at hand.

The essential question, however, is somewhat complex, although Meier has found an answer that is not difficult to apply. Instead of constructing conic sections through the workpiece, which is rather time consuming, it is only necessary to determine the relative position of two points—the intersection point of the cutter axis with the axis of the tapered hole (which is called Point *S*) and the intersection point of the perpendicular erected at the smallest diameter of the taper with the axis of the tapered hole (called Point *P*).

If Point *S* lies below Point *P*, interference does not occur; if Point *S* lies above Point *P*, interference occurs. In the latter case, the Christmas Tree portion of a turbine bucket would have a surface that would fit poorly in the assembled turbine wheel.

Surface Finish Standards

In new German surface finish standards, the mean line of the valleys and peaks of a machined surface ("M-line") has been abandoned and replaced by an envelope profile ("E-profile"). The new concept is described in an article by H. V. Weingraber appearing in *Stahl und Eisen*, Vol. 80, No. 26, 1960, p. 1933-1939. The title of the article is "Die neuen deutschen Oberflaechen Normen und ihre Auswirkungen auf die Oberflaeschen Messung." Roughness and dimensional deviation—two terms that are often confused in the M-system—are clearer in the new system, which is covered in German standards DIN 4760 and DIN 4762.

New instruments will be required for the new surface measurement system. Until such instruments are available, profiles must be evaluated graphically.

The author has made time studies comparing the M-system and the E-system and has found that correct construction of the mean line is nine times faster with the E-system.

who's meeting and where

June 1-2. AMERICAN STANDARDS ASSOCIATION. Fifteenth annual spring meeting of the company member conference. Pick-Congress Hotel, Chicago, Ill.

June 4-9. SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting. Chase-Park Plaza Hotel, St. Louis, Mo.

June 5. STANDARDS ENGINEERS SOCIETY, INC. Engineering standards seminar and selected exhibit. Carnegie International Bldg., New York, N. Y.

June 5-9. SOCIETY OF THE PLASTICS INDUSTRY. National plastics exposition and conference. New York Coliseum and Commodore Hotel, New York, N. Y.

June 6-8. INSTRUMENT SOCIETY OF AMERICA. Summer instrument-automation conference. Royal York Hotel and Queen Elizabeth Hall. Toronto, Ont., Can.

June 11-14. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Summer annual meeting. Statler Hilton Hotel, Los Angeles, Calif.

June 12-23. MASSACHUSETTS INSTITUTE OF TECHNOLOGY. Summer program on experimental techniques under the direction of the Department of Mechanical Engineering, Cambridge, Mass.

June 14-16. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Applied mechanics conference. Illinois Institute of Technology, Chicago, Ill.

June 25-30. AMERICAN SOCIETY OF TESTING MATERIALS. Annual meeting. Chalfonte-Haddon Hall, Atlantic City, N. J.

June 26-30. AMERICAN SOCIETY FOR ENGINEERING EDUCATION. Annual meeting on engineering in world affairs. University of Kentucky, Lexington, Ky.

June 28-30. Joint Automatic Control Conference. Sponsored by the INSTITUTE OF RADIO ENGINEERS, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, INSTRUMENT SOCIETY OF AMERICA, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS and the AMERICAN SOCIETY OF MECHANICAL ENGINEERS. University of Colorado, Boulder, Colo.

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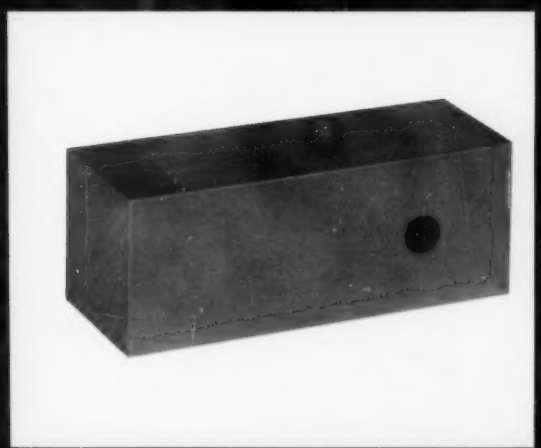

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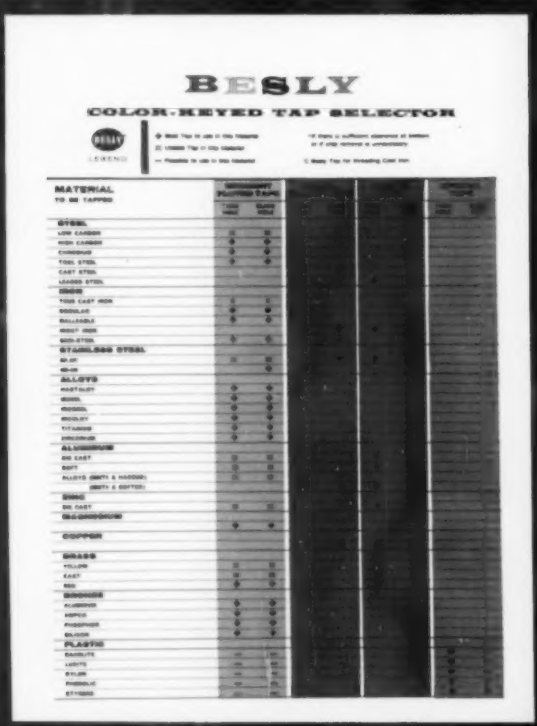
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Men at Work

Appointments of ERVIN J. OSTERHUS (pictured) as executive vice president and WALTER J. HOOD (pictured) as vice president of engineering, have been announced by Charles H. Standish, president of Designers for Industry, Inc., Cleveland, Ohio. Osterhus, formerly vice president of engineering, joined the company in 1942. He had been a senior design engineer at Goodyear Aircraft Corp. Hood, who was project manager, joined the company in 1951.

Ervin J. Osterhus

Walter J. Hood

ALFRED E. BUSCH (pictured) has been elected president of Keuffel & Esser Co., Hoboken, N. J., to succeed CARL W. KEUFFEL (pictured) who is retiring. Busch joined the company in 1938 as a salesman and for the past six years has served as vice president and treasurer. Keuffel is retiring after 48 years of service.

GLENN HERZ (pictured) and JAMES L. WOODLEY (pictured) have been elected by the Hyster Co.'s board of directors as vice presidents. Herz has been with the Portland, Ore., firm for 15 years, serving as chief engineer since 1958. Woodley joined Hyster in 1945. Prior to his election as vice president, he was manager of manufacturing.

PAUL A. WAALKES has been elected as director and appointed vice president of Alert Supply Co., Los Angeles, Calif. The company is a wholly-owned subsidiary of Hanson-Van Winkle-Munning Co., Matawan, N. J. Waalkes will continue as sales manager, his present position.

RICHARD H. LEWIN, president, Cerro Sales Corp., New York, N. Y., has announced the appointment of IVOR THOMPSON as vice president. Thompson will be responsible for marketing nonferrous metals produced by Cerro de Pasco Corp., a subsidiary operating in Peru.

The appointment of A. C. DeNAPOLI as vice president of engineering and manufacturing for Massa Div., Cohu Electronics, Inc., has been announced by Frank Massa, president. DeNapoli was chief electromechanical engineer for Motorola, Inc. prior to joining the Hingham, Mass., firm.

CompuDyne Corp., Hatboro, Pa., has elected JOHN H. CLARKE vice president of its systems division. Clarke joined CompuDyne in 1956. He was named manager of the systems division in 1959, after serving as project engineer and regional sales manager.

Crucible Steel Company of America, Midland, Pa., has appointed JOHN E. HOLT assistant to the vice president, operations and production. Formerly division superintendent, Holt joined Crucible in 1943.

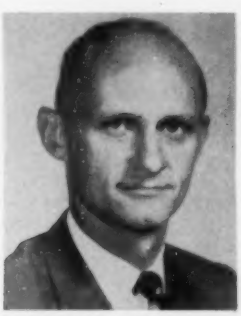
The board of directors of Elwell-Parker Electric Co. recently announced the election of SHELDON K. TOWSON, JR., as president and chief executive officer and W. A. MEDDICK as chairman of the board. Towson, previously vice president and general manager, joined the company in 1956. Meddick, a 25-year veteran of Elwell-Parker, was named president in 1958.

Sidney Machine Tool Co., Sidney, Ohio, has named E. W. WAGNER vice president and general manager. Wagner was formerly general sales manager. The company is a wholly-owned subsidiary of Buhr Machine Tool Co., Ann Arbor, Mich.

F. Steel Blackall, III, president of Taft-Peirce Mfg. Co., Woonsocket, R. I., has announced appointments of three new vice presidents: FRANKLIN MEYER, JR., engineering; KENNETH H. WILLIAMSON, manufacturing; and JOHN G. ZEIGER, marketing. In addition, DR. WALTER M. SAUNDERS, JR., has been named metallurgical director. Williamson and Meyer will direct the activities of two newly formed divisions. Williamson will be in charge of all manufacturing and Meyer will head the engineering and controls division. Zieger will continue to direct the company's marketing pro-

Alfred E. Busch

Carl W. Keuffel



Glenn Herz

James L. Woodley

Men at Work

gram. Dr. Saunders will head Taft-Peirce's contract heat treating activities and serve as staff consultant on metallurgy.

MILTON E. SLATER has been named executive assistant to the president of Thor Power Tool Co., Aurora, Ill. Slater will join the executive management staff of Thor in the general corporate administration of the company's divisions and subsidiaries in all areas of product development, sales and production.

Dr. R. D. O'Neal

The Bendix Corp., Detroit, Mich., has assigned two executives to the company's administration committee: DR. R. D. O'NEAL (pictured), vice president in charge of engineering, and R. H. ISAACS, vice president in charge of government relations. The committee is responsible for major policy and operational decisions affecting the entire Bendix organization.

C. GLEN BIGELOW, JR., has been named vice president of research, Selas Corporation of America, Dresher, Pa. Bigelow joined Selas in March 1958 as director of research. Previously he was associated with American Machine and Foundry Co. and Loftus Engineering Co. A graduate of Purdue University, Bigelow is a member of the Industrial Research Institute, Inc., American Society of Mechanical Engineers, National Association of Manufacturers, Instrument Society of America, American Ordnance Association, and the Scientific Research Society of America.

Pratt & Whitney Co., Inc., West Hartford, Conn., has announced the appointment of MARK G. CHANNING as vice president in charge of planning. Channing's duties will include long-range corporate planning, cost controls, business research and product planning. Previously with Chrysler Corp. as director of market representation, he

has a broad range of experience in the field.

Appointment of PETER H. PONTA as director of Ford Motor Co.'s manufacturing staff, Dearborn, Mich., has been announced by John Dykstra, president. Ponta has been director of manufacturing engineering and development since 1960. Previously he served as general manufacturing manager of the engine and foundry division. Ponta joined Ford in 1937 as an apprentice draftsman.

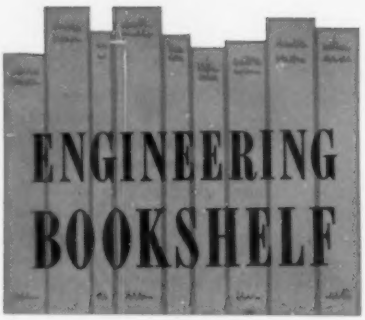
R. C. Mahon Co., Detroit, Mich., announced the election of ROBERT C. PALMER as president and director. Palmer, before becoming associated with Mahon, served as president of Ingalls Iron Works, Birmingham, Ala. WALTER F. SHEETZ, formerly president of Mahon, will continue with the company as chairman of the board, treasurer and chief executive officer.

JOHN F. TORLEY has been elected president and general manager of Dayton Malleable Iron Co., Dayton, Ohio, replacing ANTHONY HASWELL, who is newly elected chairman of the board of directors. Torley was previously vice president of National Malleable and Steel Castings Co., Cleveland, Ohio. Haswell has served as president since 1942, and will continue to be active in the company.

Allison K. Simons

ALLISON K. SIMONS (pictured) has been named vice president of Bostrom A. G., an international affiliate of the Bostrom Corp., Milwaukee, Wis. Simons will work in the company's headquarters in Switzerland. Previously he was director of Bostrom Research Laboratories. He has been with the company for the past 11 years.

JOHN J. KOVACS, who heads a number of industrial enterprises in the New York metropolitan area, announced recently the appointment of RONALD E. COLLINS as president of Vacculator Co., Inc., Newark, N. J. Collins is a graduate of Cambridge University, England.



METALS HANDBOOK, 8TH EDITION—*Published by The American Society for Metals, Novelty, Ohio. Price $30. 1300 pages.*

Coverage of the all-important subjects of selection and properties of metals has been greatly expanded and intensified in the new ASM Metals Handbook, a principal part of which deals with the selection of tool materials for specific types of tools. The book is the first of a projected series of volumes which, when completed, will cover all branches of metals engineering and metalworking. Major sections of the book, in addition to tool materials, are: carbon and low-alloy steels, cast irons, stainless steels and heat-resisting alloys, nonferrous metals, and magnetic, electrical and other special materials.

Consisting of 22 articles, prepared by 20 committees of ASM, the tool material section includes 400 specific comparisons of tool wear, tool life and tool economy in production. Coordinated with these extensive production data are 71 selection tables which recommend tool materials for 2300 applications of specific tools. The 248 contributors to this major section represent virtually all of the supplying and consuming industries; in addition to their main contributions on selection of tool material, these specialists have included much information on tool design.

COST REDUCTION GUIDE FOR MANUFACTURING MANAGEMENT—*By H. Clifton Morse and E. E. Wyatt. Published by Wyatt and Morse, Inc., 332 S. Michigan Ave., Chicago 4, Ill. Price $18. 256 pages.*

Because cost reduction is a subject of vital concern to engineers at, and below, the management level, this book should have a high level of readership. Well-written, clear and concise, it is divided into four major sections, the first of which discusses organization, development and promotion of a sound cost-reduction program. Section Two discusses actual case histories of cost-reduction programs. The remaining sections are devoted to a detailed discussion of the tools of management—from computers to Operations Research.

GRAPHICAL COMMUNICATION—*By Earl D. Black. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $8. 328 pages.*

Written by the Head of Engineering Drawing and Kinematics at the General Motors Institute, this book deals primarily with the problems in graphical communication encountered in present-day manufacturing. Basic fundamentals are well covered as is the theory of drawing, tolerances and dimensions. A number of projects listed at the end of each chapter makes this book especially useful to students of drawing.

BROACHING — TOOLING AND PRACTICE — *By Horace E. Linsley. Published by The Industrial Press, 93 Worth St., New York 13 N. Y. Price $6.50. 216 pages.*

Because little has been written in book form about the techniques and equipment used in broaching, this book fills a sizable gap in modern technical literature. As such it should prove useful to management, engineers, purchasing agents and students of engineering. Topics discussed include the theory of broaching, types of broaching, broach design, machines, tooling, setups and maintenance.

DESIGN OF WORM AND SPIRAL GEARS—*By Earle Buckingham and Henry H. Ryffel. Published by The Industrial Press, 93 Worth St., New York 13, N. Y. Price $15. 450 pages.*

The engineering aspects of worm gearing are examined in detail in this book. Problems covered include design of gears for indexing and power transmission; gearing with shaft angles less than 90 deg; acceleration and dynamic loads; radiation of heat and oil cooling; and mechanical efficiency of worm and spiral drives. This book will prove useful to engineers seeking a depth treatment of the problems of gearing.

PRINCIPLES OF MANUFACTURING MATERIALS AND PROCESSES—*By James S. Campbell, Jr. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $9.75. 674 pages.*

Useful as a text or reference work, this book outlines the processes and materials used in modern manufacturing. Written to the advanced undergraduate level, it relies heavily on the reader's knowledge of basic science and engineering fundamentals. Detailed descriptions of the machinery currently used by industry are also given. These provide the reader with schematic drawings of machine functions and cutting-tool action for each machine discussed. In addition, much information is provided on the basic setups commonly used in machine shops and production lines.

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technical shorts

Die Cleaning—Hydraulic jet units are simplifying the cleaning of draw dies at the Ford Motor Company's Dearborn stamping plant. These units mix water with steam and detergent under high pressure to form a hot jet discharge stream. The impact of the stream quickly and thoroughly removes accumulated drawing compound and sludge from the interior of die.

Rust Inhibitors—Recent research at Battelle Memorial Institute reveals that calcium and zinc molybdates equal or exceed the rust-preventive characteristics of red lead and other inhibitors commonly used. It has also been shown that molybdates have two other advantages not shared by red lead, zinc chromate and iron oxide in that they are nontoxic and white. In evaluating the rust-inhibiting characteristics of the molybdates, scientists exposed coated panels to accelerated weathering conditions in laboratory weathering equipment.

Since molybdates are relatively nontoxic, they are acceptable in several applications where conventional rust preventatives cannot be used, according to Battelle. Such applications include food-processing machinery, food storage containers, water tanks, and water transmission lines.

Epoxy Blanking Dies—Epoxy resin is now used to fabricate blanking dies for stamping small electrical and aircraft components from aluminum sheet steel. The process utilizes the finished punch—made of Kirksite or cold-rolled steel—as a form, around which the epoxy is poured. The epoxy, a product of Ren Plastics, Inc., is poured with a hardening agent at a ratio of 5 to 1. Use of epoxy for blanking dies has resulted in runs of 500 parts on aluminum ranging up to 0.060 inch thick.

Nitrided Steel—A new heat-treating process for removing the white layer from nitrided steel parts such as aircraft production gears, master gears and bearings has been developed by metallurgists at National Broach & Machine Co. Called "Ban-Wite," the process is carried out by coating the nitrided steel part with an impervious, heat-resistant material; heating the part under controlled conditions, and then removing the coating. In addition to removing the white layer, the process also tends to increase case depth.

Surface Carbon—New information on the effect of surface carbon on structural performance of bolts and similar heat-treated components has been disclosed in a laboratory report published by Standard Pressed Steel Co. According to the report, both surface decarburization and carburization significantly reduced tension fatigue life of the bolts tested. Optimum performance was obtained with controlled heat treatment which produced uniform carbon content —and thus, uniform heat-treated hardness—throughout the bolt cross section. Even slight excesses or deficiencies of surface carbon detracted from bolt performance.

Tape Controlled Rifling—Tape control is now supplanting the rifling "ribbon" traditionally used to guide cutting tools in the rifling of artillery pieces. Elimination of the ribbon—actually a template 15 to 25 feet long—has resulted in faster setups and increased accuracy in production as well as in experimental ordnance work.

Tech Digests

Bonding Sandwiches

Structural adhesives suitable for the bonding of the metal components which make up a structural assembly have developed rapidly over the past decade. Many new adhesive systems have been presented, and the military specifications describing the minimum requirements for acceptable materials have gone through several revisions. Adhesive research has resulted in the development of two general types of adhesives—those intended primarily for bonding continuous metal skins to each other, and those intended primarily for attaching metal skins to honeycomb sandwich core. These two distinct classes, developed to their ultimate, are not interchangeable, and if used interchangeably, perform poorly in the application for which they were not intended. Unfortunately, most sandwich construction contains areas where metal-to-metal bonds are necessary, such as inserts, edge bonds, attachment channels, extrusions, etc. The sandwich fabricator, hence, is presented with the choice of either accepting less than optimum performance in some portions of his bonded assembly, or expending extra effort and expense in order to use two adhesive systems in each part; i.e., one adhesive for metal-to-metal areas and another adhesive for sandwich areas.

The development of sandwich adhesives thus far has been more of a physical form modification than a materials development, since the materials used in sandwich adhesives generally have been the same as those used in metal-to-metal adhesives. Unlike metal-to-metal bonding, where pressure is always used, the sandwich bond must form without pressure, since the main part of the bond consists of the fillet formed at the base of the metal foil which makes up the honeycomb core. The amount of adhesive trapped between the edge of the core and the skin is too small to contribute any significant strength to the joint. Therefore, the formation of a fillet around the base of the core is necessary if the adhesive is to produce a satisfactory joint. The phenolic-nitrile blends fail to form satisfactory sandwich adhesives for two reasons. First of all, at no time during the curing cycle do they become fluid enough to permit surface wetting to redistribute any of the adhesive in a manner favorable to sandwich bonding. If a phenolic resin-nitrile rubber blend dry film adhesive is used for sandwich bonding, the resulting glueline will have a reverse fillet.

Up to the present time, most structural sandwich adhesive systems have the following common characteristics:

1. They consist of nonhomogeneous blends of two or more resin systems
2. They contain a fabric carrier
3. They contain phenolic resins blended with an elastomer.

Because of the years of background, the above characteristics have become accepted as the proper makeup for a sandwich adhesive. However, in carrying out our sandwich adhesive research program, we questioned whether these concepts are a necessary part of the makeup of any sandwich adhesive system.

Because of the past difficulties encountered in using phenolic resins in structural adhesives, it was decided to attempt to develop an epoxy resin system with the desired degree of elasticity. While previous attempts in this area had failed, preliminary experiments on the blending of selected epoxy resins with certain elastomer systems suggested some hope of success. After a series of screening tests, the nylon resin systems were chosen for a more extensive evaluation in combination with certain epoxy resins. While nylons in general tend to be incompatible with epoxies, it was found that, under specific processing conditions, compatibility with certain epoxy systems could be achieved over selected composition ranges. The results of this study indicate that a whole family of new adhesive systems, consisting of blends of epoxy-resins, can be prepared. Within certain ranges, a variety of unique adhesive properties can be achieved.

Because epoxy-nylon combinations are only approximately eighteen months old, they have not yet had a chance to become established in actual production, except for somewhat restricted uses. However, experimental parts of various configurations have been fabricated successfully. Because of the excellent combinations of physical properties, plus the exceptional ease of fabrication, it is expected that epoxy-nylon combinations will find extensive use in a wide variety of metal-to-metal and sandwich applications. Also, it is reasonable to assume that laboratory developments will result in further expanding the usefulness of these systems, and that adhesives capable of operating at higher strength levels over wider temperature ranges will be forthcoming.

From a paper, "Adhesive Bonding a New Concept in Structural Adhesives" by Frank J. Riel, Narmco Industries, Inc., San Diego, Calif., presented at the 17th Annual Technical Conference, sponsored by the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

Metal Cleaning

In the past decade, several developments have occurred that are important in cleaning metal to be coated with porcelain. Sequestering, to form water soluble complexes with polyvalent metal ions, is one of these. It means reducing the calcium and magnesium found in most water to absolute inactivity, plus removing traces of impurity. This does away with hard water coating of magnesium and calcium salts. Since the salts are water soluble, they are completely removed in the rinse. It also eliminates rejects due to soluble metallic salts on the ware.

Glassy phosphates, though not true chemical compounds, can be prepared

in any acid range desired. This means these cleaners can be prepared to clean aluminum without attack. It can be used on both ferrous and nonferrous metals with equal effectiveness. This should reduce the neutralizing of acid baths due to carryover of alkali from the rinse tank.

Wetting agents, or surface active agents have only recently been made available in noncorrosive form. Three grades of wetting agents are available; cationic, anionic and nonionic. This makes a considerable difference in the effective life of a solution and in uniform results. Availability of nonfoaming wetting agents materially increases the utility of alkaline cleaners in spray pickle.

Soaps from resinous fatty acids combined with completely saponified rosin soaps do away with the scumming and subsequent rinsing difficulties which previously plagued cleaning in a pickle line. Ultrasonic cleaning, the use of inaudable sound waves, is proving useful in removing all kinds of soil.

Use of two entirely different types of baths, first, an extremely heavy-duty cleaner, and the second, a chemical bath to insure chemically clean surfaces is proving useful. The first bath removes practically any type of soil, and the second removes any traces of the original heavy-duty cleaner and leaves a surface that is easily rinsed. This process has proven to have considerable merit.

From "What's New In Metal Cleaning," by G. A. Cairns, The Macco Products Co., 9210 S. Sangamon St., Chicago 20, Ill., presented before the Midwest Enamelers Club, 1961.

Managing Engineers

The impact of changing technology and its explosive nature have generated many acute problems of engineering management. The sensitivity of the engineering profession to need, and challenge, and opportunity, has enabled engineering management to face up to its challenge realistically and adequately.

These conditions arose at a time when the number of engineering graduates had dropped to an alarmingly low level. This situation continues and there is fear in the minds of many that the continuous emphasis on encouragement of more and more of the young to enroll for scientific courses may cause difficulty in maintaining engineering enrollments at their present level let alone increase them as should be done.

The profession has been alert in taking advantage of the many new working tools which have become available. High-speed computers are in general use. These not only save valuable engineering time but, in many cases, their greatest value lies in permitting the engineer to explore a whole field of alternative possibilities and select the one which will result in optimizing capital and operating costs with maximum economic advantage.

Systems engineering has been widely adopted with economic advantage in plant design and control. Industry made a start in the application of operations research during the preceding decade

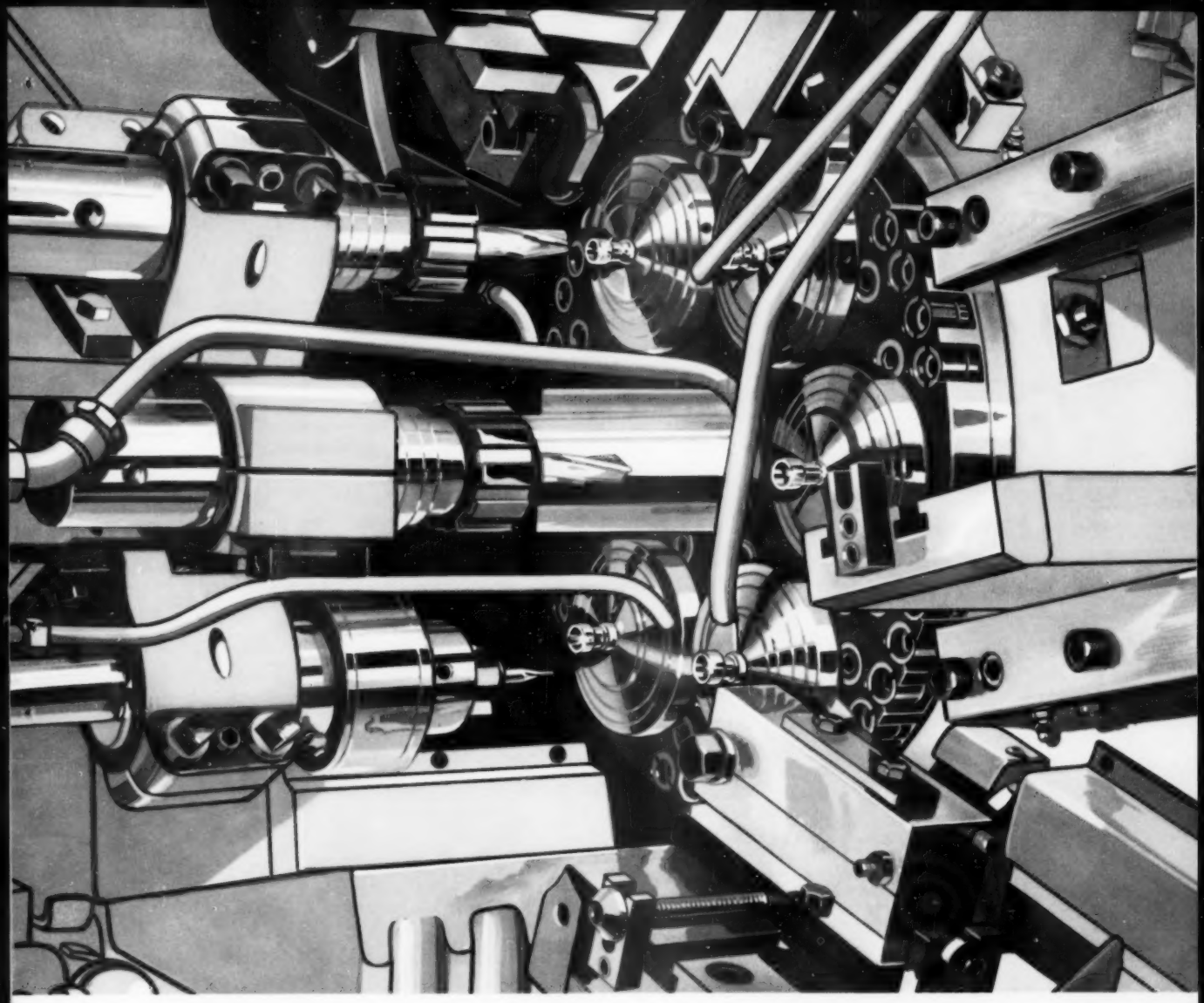
TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

and has greatly expanded its use. Unlike some early concepts that this could function best when carried out by persons with no knowledge of the problem, it has been found that best results are attained by teamwork.

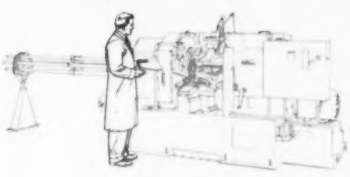
While not new to this decade, the task-force concept has been extensively applied. Here persons of different intellectual capability and experience are assembled to bring their combined knowledge to bear on given problems. When they have completed their work on the problem at hand, the force is disbanded and the personnel reassigned. Such a task force may be assembled on a purely engineering problem; for example, a plant design.

Engineering has carried an increasing responsibility for product quality. This has increased the degree that reliability engineering has evolved as one of the new activities of the decade. Increasingly complex products with an

(Continued on page 167)



The newest bar machines *are New Britains*



How much work can you wring out of a bar machine? It depends on the machine, how it's tooled and who's using it. New Britain's New-Series Bar Machines are setting some pretty enviable productivity records right now. These machines, redesigned from the ground up, are the most advanced units of their kind available to the metalworking industry.

The four-spindle machines have capacity up to 5⅛″ and all the massiveness and power needed to turn work of this size.

New series six-spindle machines in various models have capacities ranging up to 3½″. The eight-spindle machines take work to 2⅝″ capacity.

Increased capacity is only part of the story. Tooling combinations are practically limitless. With end-working and cross slide tooling in every position on every model, the greatest possible variety of operations can be performed to the highest order of accuracy. Numerous familiar New Britain features, like spindle carrier lifting and locating, have been retained and improved. A great many exclusive new features have been added.

Why not send for our new catalogs which give the whole story in detail or call your New Britain representative to arrange a demonstration?

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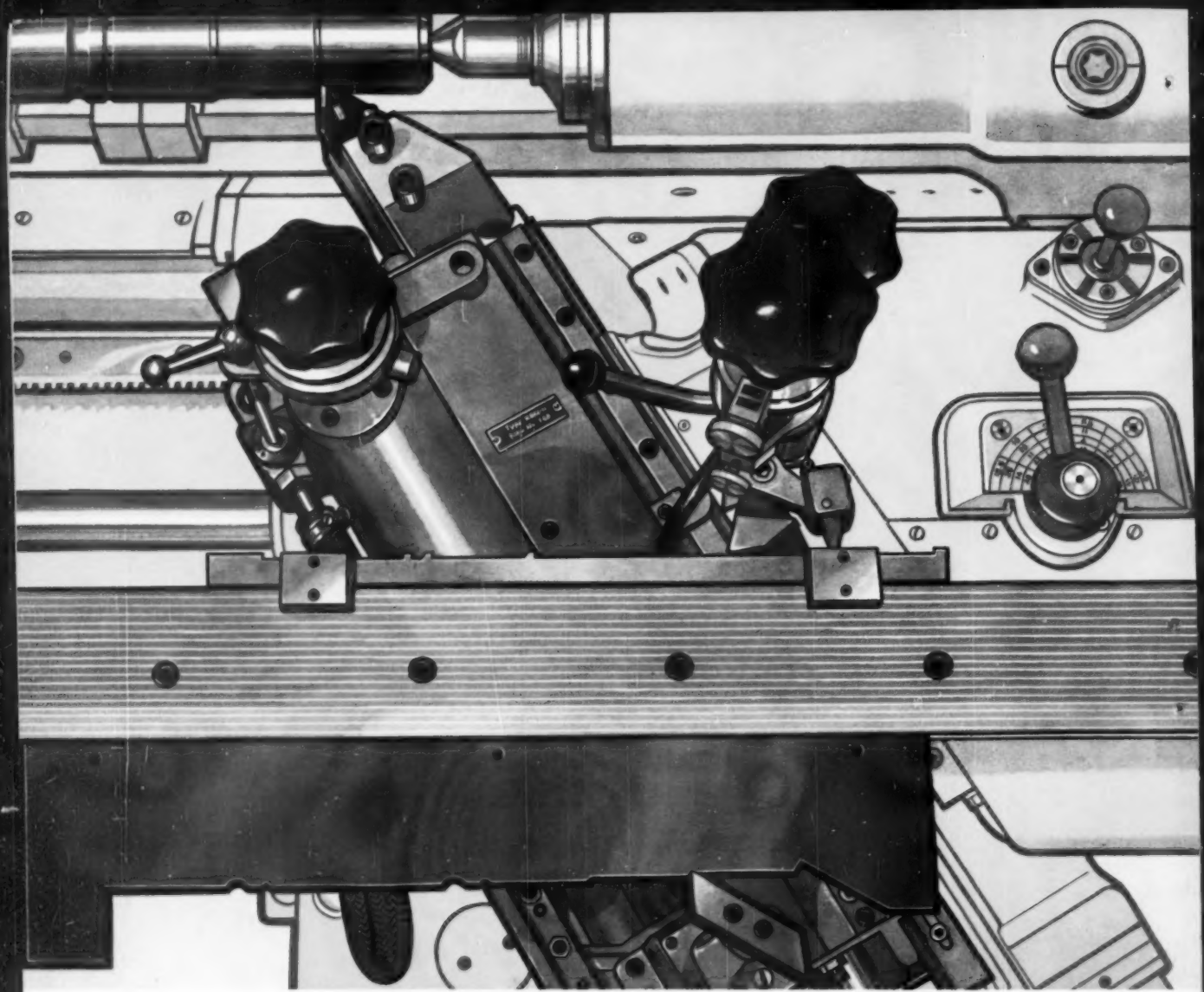
New Britain-Gridley Machine Division ◆ New Britain, Connecticut



Fast set-up, quick changeover *with New Britain +GF+ copying lathes*

The basic design of a New Britain **+GF+** copying lathe can start to save you money on the first job you put on it. Because the single tool is guided by either a prototype or a template, set-up time is reduced to minutes. The single tool can be changed in minutes, too. Every dimension is positively transmitted from template or prototype to the work, making adjustment a simple matter of bringing only one dimension to size. A **+GF+** does a great variety of work—shafts, chucking work, internal *and* external copy turning. Backfacing is accomplished by a simple attachment. Multi-cut recycling for the removal of heavy stock concentration can also be provided.

The versatility of application is pretty much limited only by the ingenuity of the individual. For more complicated jobs, New Britain can provide the most complete selection of steadies, special tooling attachments and other accessories available for any lathe anywhere. A complete range of models and sizes is available. Why not write for our new **+GF+** copying lathe catalog?

THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division ◆ New Britain, Connecticut

ever-growing number of component parts are creating more and more severe dependability requirements. Requirements for existing products become increasingly severe so that the user can have greater benefit from them. New products are expected to possess better properties than existing ones. Old standards of establishing over-all requirements for finished products no longer suffice.

Much has been accomplished during these years by streamlining organizations; improved training for engineers; freeing them of routine chores to make their time available for truly technical work; by making them increasingly cost conscious; by more thorough planning of work; and by utilizing the many techniques and working tools which have become available. Much more remains to be done in securing their maximum benefits.

From a paper, "Practices in Operational Management—Engineering Management" by C. E. Paules, vice president of Engineering (Ret.), Esso Research and Engineering, presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Creativity in The Organization

A classic function of the university is to appraise and assess the life and times of the society which it serves. One of its most urgent questions today is to determine the place of the individual in a world committed irrevocably to organizational procedures. In recent generations the increasing complexity of society, life and learning have become too diffuse for anyone to live in isolation. Society has become so intricate that specialization is necessary.

Because of specialization, we look to organizations as responsible instruments of human achievement. For organizations, and for our society, the problem is how best to preserve the creative power of the individual in the face of organizational necessity.

There is an inherent danger in man's involvement with large numbers of his kind. The problem is not solely one of protection for the individual, it is also protection of the organization from stagnation created by conformity. Instead of the individual becoming the victim of pressures within the organization, it is the organization that sometimes falls prey to organization men.

Conformity in behavior is a necessity; conformity in thought a danger. Cooperation is a necessity at any time, but the premium is and always must be on original approaches. An organization does not flourish by virtue of the superior talents it enlists. Its advancement derives from having provided for its

people a climate of achievement in which men of ordinary stature are stimulated to extraordinary performance. This process, through which common men perform uncommon deeds, cannot endure in the face of anything that deprives the individual of his dignity or his importance. Nor can it exist in our intricate day in an anarchic atmosphere.

Achievement begins with the human intellect. Organizations are without this capacity. They exist and prosper only as they can give free rein to the minds and spirits of their people.

From "The Individual in the Organization," by Crawford H. Greenewalt, president, E. I. duPont de Nemours & Co., Inc., Wilmington 98, Delaware., presented at Princeton University.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Product Planning and Engineering

A product planner is a creative coordinator who works with engineers, stylists, marketers and general management to achieve uncommon solutions to common problems of product development.

He has the responsibility of keeping the operation moving efficiently and profitably this year. He must have sound plans for future years. For example, the 1964 car. This involves questions in several areas. Marketing—what will people want in 1964? What volume objectives are feasible and reasonable? Engineering—can they design the kind of car indicated? Are new features suggested? Cost—there must be a satisfactory return on investment. The car must be costed out, part by part. Style—styling themes and styling direction must be determined.

Product planning is a separate function. Its basic job is to collect, analyze and evaluate data; second, to prepare findings and conclusions intelligible to management; and third, to make specific product recommendations. They generally have training and experience in manufacturing, engineering or business administration. They are creative in the sense that they suggest areas for others to explore, but they neither style nor do they design. In the final analysis, product planning is an equal partner with engineering and styling. To illustrate the relationship between engineering and product planning, the development of a specific product, the Falcon, can be traced. The program began as a

tech digests

result of market studies that had been underway for several years. On the basis of what marketing research studies revealed, product planning arrived at performance, size, weight and economy objectives for the car. These were discussed with engineering, and engineering made recommendations.

As the project developed, engineering and market research altered the initial product plan. A completely new product plan was then developed. Engineering entered on an ambitious design simplification program. They obtained and analyzed almost every small car and six-cylinder engine produced. They then set objectives for simplicity, weight, quality and economy, within the established price performance objectives. By design simplification, the car quality, function, and performance was improved, yet with 200 fewer body parts than that of a standard car, with the door having 31 fewer parts and an engine having 120 fewer parts.

Cost of every component was carefully computed. Use of existing facilities was examined. This sometimes meant redesign to determine whether greater interchangability of parts could be achieved. Marketing, on the basis of new data, made recommendations that product planning carried to engineering. At the same time, engineering recommendations were checked against the market. Thus, the two worked together to develop the recommendations. This kind of interaction typifies the work of engineering and product planning. It conclusively demonstrates the value of having them as two separate functions.

To meet today's requirements, we must continually draw upon the best ideas developed by everyone. Engineering has always produced many of these ideas. By coordinating engineering ideas with the contributions of others, product planning helps to give them maximum effectiveness.

From "The Relationship of Product Planning to Engineering," by James O. Wright, vice president and group executive, Ford Motor Co., presented at the National Automobile Week luncheon of the Society of Automotive Engineers, 485 Lexington Ave., New York 17, N. Y.

Shrinkage in Plastic Molding

Shrinkage has been defined as the difference between corresponding linear dimensions of the mold and of the molded piece, those measurements being made at room temperature. This is a general definition and does not specify the time at which these measurements are to be made nor the accuracy requirements of these measurements. It is well-known that the shrinkage of plastics varies consider-

ably. Phenolics, for example, may shrink as little as 0.001 inch per inch, whereas polyethylene may shrink as much as 0.050 inch per inch. Modified or impact polystyrene has been found to shink anywhere from 0.002 to 0.006 inch per inch when measured according to the ASTM method.

The effect of different molding conditions on the shrinkage of modified polystyrene was recently studied in detail. This study was brought about by problems encountered in the field, as is the case with many projects which originate in development and technical service departments.

The shrinkage of molded bars of two high-impact rubber-modified graft copolymers was studied by determining the effects of different molding conditions on the dimensions of the parts, on their rate of shrinkage and on the weight of the pieces. It was determined that changes in the molding conditions affect the dimensions of the pieces but that their rate of shrinkage with time is constant and independent of these conditions. Certain variations in the molding conditions affect the initial dimensions of the bars more than others. These are changes in the cylinder temperature, the mold temperature and the injection pressure. Changes in the feed cushion, booster time, and the injection and cooling periods affected the lengths of the pieces in a lesser degree. Low temperatures and lower pressures reduced the initial lengths of the bars. The weight of the pieces increased with increasing cylinder temperatures although their density remained constant. The findings explained the phenomena noted during a field trial on the two materials.

From a paper "Effect of Molding Conditions on Shrinkage of Modified Polystyrene," by R. G. Hochschild, Koppers Co., Inc., Plastics Div., 801 Koppers Bldg., Pittsburgh 19, Pa., presented at the 17th Annual Technical Conference, sponsored by the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

High-Temperature Epoxy Molds and Dies

New high-temperature molds and dies are being produced economically and quickly using high-temperature epoxy materials in combination with aluminum and fiber-glass cloth. Two general methods are used to produce these low-cost tools.

The first uses aluminum needles and high-temperature epoxy. This is generally used for light-weight vacuum-forming molds. Metal tubing for water cooling can be incorporated if desired. These materials are also used to make the male and female tools used in the manufacture of reinforced plastic parts.

In the second method, high-temperature epoxy materials and glass cloth are used for fabricating male and female tools for bag molding wet laminates of polyester, phenolic, or epoxy resins. By using these easily constructed tools, parts can be produced with a minimum of time, money and equipment.

There are several choices of resin systems as well as hardener systems. The material can be machined, drilled and tapped. Several types of guide arrangements can be employed. Examples are shown in the paper.

From a paper "Fabrication of High-Temperature Molds and Dies Using New Epoxy Resin Systems," by Tom Schaub, Furance Plastics, Inc., 4515 Brazil St., Los Angeles 39, Calif., presented at the 17th Annual Technical Conference, sponsored by the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

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Put the new Delta 12" Cut-Off Machine through its paces. Take a sample work piece to your Delta Distributor—cut it—judge this tool on results!

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ENGINEERED RUBBER PRODUCTS ... MORE USE PER DOLLAR

Charles Saenger, Chief Metallurgist for the Illinois Tool Works in Chicago, Illinois.

CHARLES SAENGER tells how Lindberg equipment produced better cutters and hobs

QUOTE

"Unground form cutters and hobs require certain refinements above and beyond those needed for ground tools. Our Lindberg-Upton salt-bath units and daily chemical control of the salt-bath solutions help us maintain an excellent surface condition and hold to critical dimensional tolerances and close hardness range required by these tools. We are very well pleased with the consistent, trouble-free service our Lindberg-Upton furnaces have provided month in and month out."

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Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., 15 Pelham Ave., Toronto 9, Ont. Also, Lindberg plants in Argentina, Australia, England, France, Italy, Japan, Spain, Switzerland and West Germany.

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John Crane

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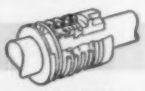

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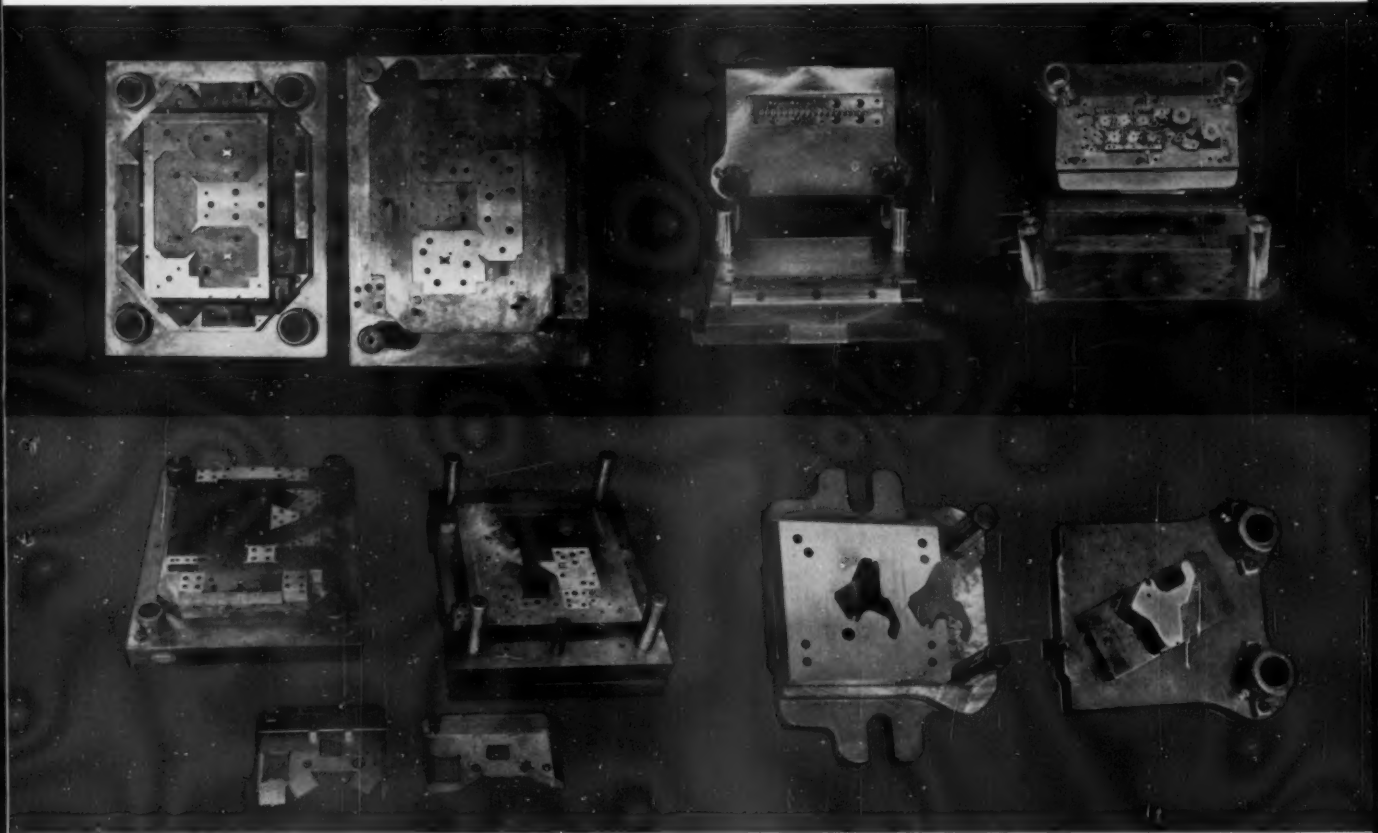

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**These grades are also available Precision Ground in flats or squares—ready for immediate production use. Satin smooth finish. Square, sharp corners. Protective wrapping. The sizes you want (in the hundreds!)*

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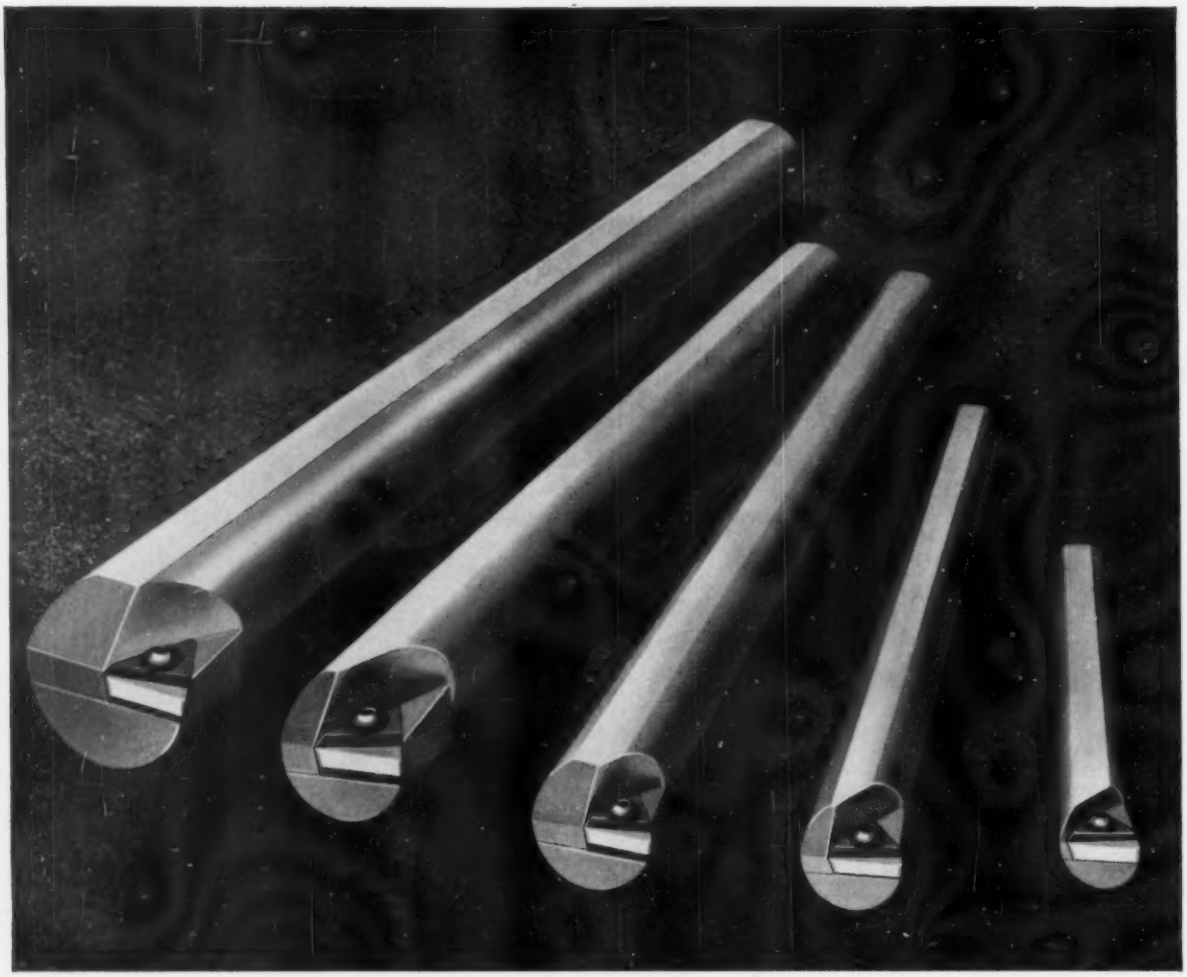

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. . . 5 small diameter bars designed for precision boring

The combination of a Kennametal* shank, three times as rigid as steel, and Kendex "throw-away" inserts, with three indexable cutting edges, provides many cost-reducing advantages for high precision boring.

Small diameter K-Bars practically eliminate chatter, deflection, and vibration. As a result, they assure straighter holes, closer tolerances, and a better finish that often eliminates subsequent grinding. A K-Bar can often remove as much metal in one pass as a steel bar would remove in two or more passes. The ratio of length to diameter of K-Bars with Kennametal shanks exceeds the practical limits of bars with steel shanks.

BB-7000 K-Bars are available in diameters from 3/8" through 1", with minimum bore diameters ranging from .500" to 1.375", and chip breakers made of Kennametal for better chip control.

For more complete information—and a demonstration of BB-7000 K-Bars—call your Kennametal Representative, or write KENNAMETAL INC., Latrobe, Pa.

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When purchased as a set, the five bars are delivered in a sturdy oak case for protection and convenient handling in tool rooms. The "package" also includes extra inserts and spare parts.

Five Sizes of BB-7000 K-Bars Positive Rake • Solid Kennametal Shank					
Diameter	3/8"	1/2"	5/8"	3/4"	1"
Length	6"	8"	8"	10"	12"

Larger Diameter K-Bars available with adjustable heads.

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loosens the socket head screws—the removable caps are pushed up through the bushings . . . then the punch holder virtually floats on the guide pins. That makes it a simple matter to lift the punch holder off the die shoe. Tilting or uneven lifting is not a factor when removable cap pins are used. THERE'S ABSOLUTELY NO TROUBLESOME BINDING IN PARTING DIES.

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Should foreign matter cause pin and bushing seizure, the socket screw pulls out of retaining washer . . . then the matching taper of pin and cap act as guide to prevent costly die damage.

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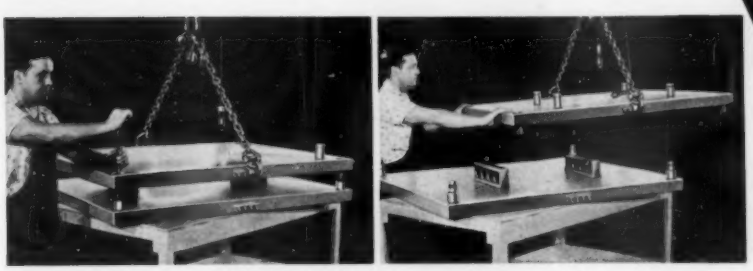

One man parts large die set in a few minutes with Superior Removable Cap Guide Pins

NOW ON ALL SUPERIOR DIE SETS IN DIAMETERS FROM 1½" UPWARD AT NO ADDITIONAL COST.

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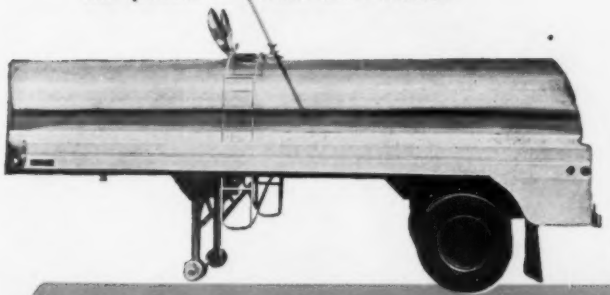

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NETS $58,000 DIVIDEND/YEAR!

Inefficient and outdated power tools were costing this plant money. A power tool study revealed that in the assembly of tank trucks alone, 29 out of 66 tools were operating at only 40 to 50% efficiency.

New, more efficient Ingersoll-Rand Air Tools with full power and speed replaced the old tools. Fifteen additional I-R tools were installed to cut fabrication time on other operations. Leaks, faulty oilers and air filters were corrected. The net result: increased production that amounted to a $58,000 Dividend on Payroll Dollars the first year.*

With production increases making up the full cost of the tool replacement program in just 58.6 working days, an immediate Planned Annual Retooling program was started to maintain peak tool efficiency and maximum output.

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*For details, call your I-R AIRengineer or write Ingersoll-Rand, 11 Broadway, New York 4, N.Y.

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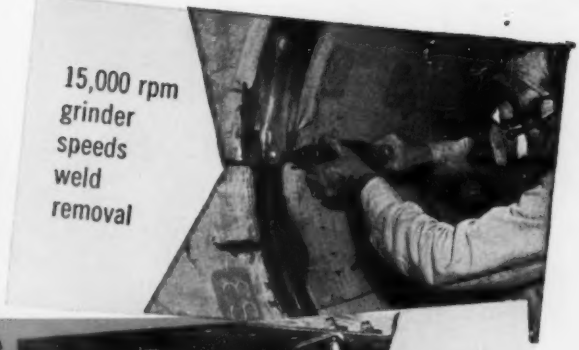
Planned Annual Retooling increases output per man

15,000 rpm grinder speeds weld removal



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Portland
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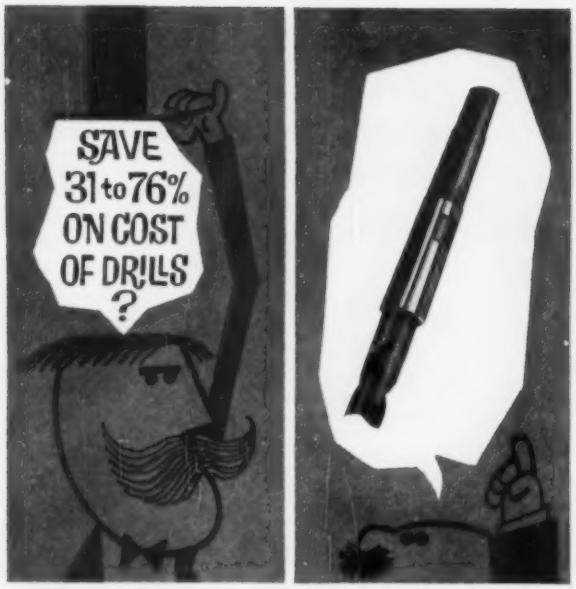

With Scully-Jones Style "B" Drill Chucks . . . those "reusable taper shanks" for inexpensive straight-shank drills. Besides saving 31 to 76% on price of taper-shank drills, you avoid their inventory cost. Positive, four-slot grip of a Style "B" chuck also drives reamers, end mills, and similar straight-shank tools. Ask for free literature—Cost Saving Idea No. 2.

SCULLY JONES **Scully-Jones and Company**

1915 South Rockwell Street, Chicago 8, Illinois

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Rx PRESCRIPTION FOR BETTER TOOLING

Carr Lane Recommends

Just a few of the many CARR-LANE items that will put 'sick' tooling back on its feet! Let CARR-LANE be your stockpile of Jig and Fixture components you'll get 'em faster and of better quality from CARR-LANE

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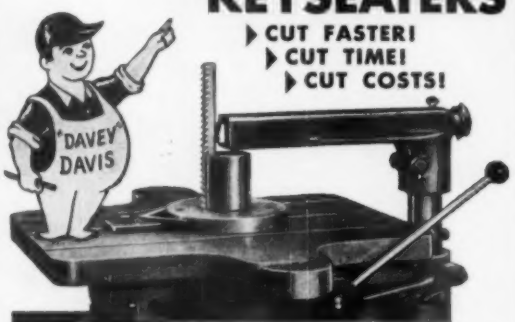
Little "Davey" says: DAVIS KEYSEATERS

- CUT FASTER!
- CUT TIME!
- CUT COSTS!



WRITE TODAY for FREE Literature

"Davey" knows that machinists' time is valuable today and that by using the Davis multiple tooth cutter principle, time is cut to a fraction of the single tooth method. Adjustments are held to a minimum and cutting speed is always maximum, regardless of size or length of cut, or the material being worked. Simple to use even for an unskilled operator. Many of our original models are still giving efficient service after years of use. Tell us your problem. We'll be glad to help solve it.

DAVIS KEYSEATER COMPANY

Division of Hansford Manufacturing Corporation
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ANNOUNCING

THE HOLOMATIC COMPACT

SIZE "J" AIR AND HYDRAULIC POWERED FEED UNITS

- Built-In Versatility
- Amazing Power to Size Ratio
- Quick Speed Change Drive
- Adjustable Rapid Travel Distance
- Adjustable Stroke Length
- Adjustable Feed Rate
- Wide Work Range (1/64 to 3/8" drill and No. 0 to 7/16" tap in mild steel)

3 Models...3 Power-Feed Styles

The new Holomatic family of "compacts" . . . the Size "J", are self-contained, reciprocating quill type power-feed units for use on production drilling, reaming, facing, tapping, threading operations. Used individually or in groups with manual or automatic cycling. Available in 3 "compact" models with 3 power-feed styles with built-in cycle and movement control systems to meet every conceivable need more efficiently and economically.

Write Today . . . for in-plant demonstration . . . or additional information, specifications and low, low prices on the new series "J" units.

Hause **MACHINES, INC.**
MONTPELIER, OHIO

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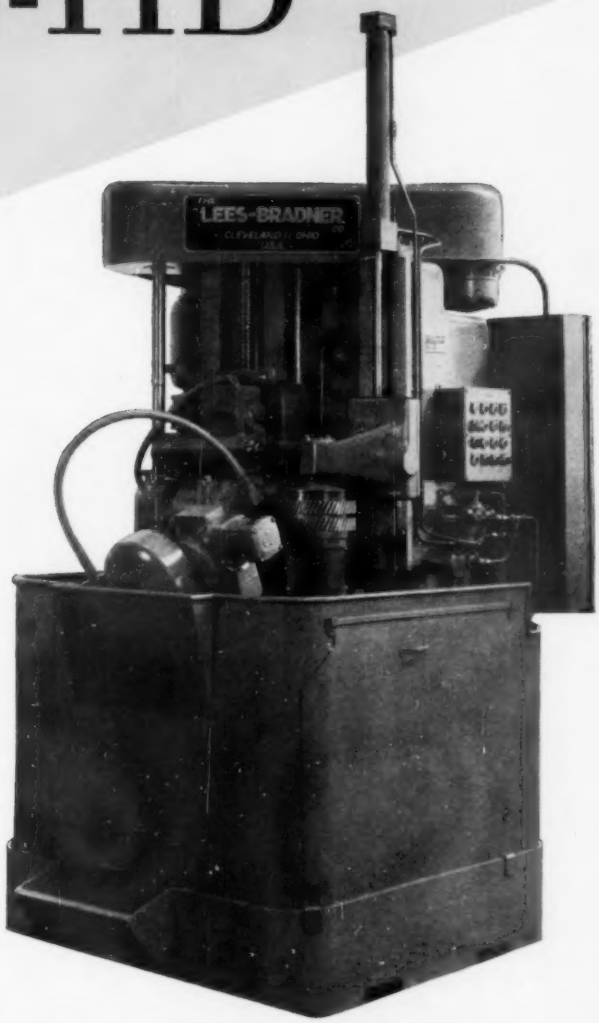
The New

LEES-BRADNER 12-HD

Heavy Duty

GEAR HOBBING MACHINE



LARGE GEARS FOR HEAVY EQUIPMENT AT HIGH PRODUCTION SPEEDS

IMPROVING GEARS FOR 50 YEARS

the LEES-BRADNER *Company*

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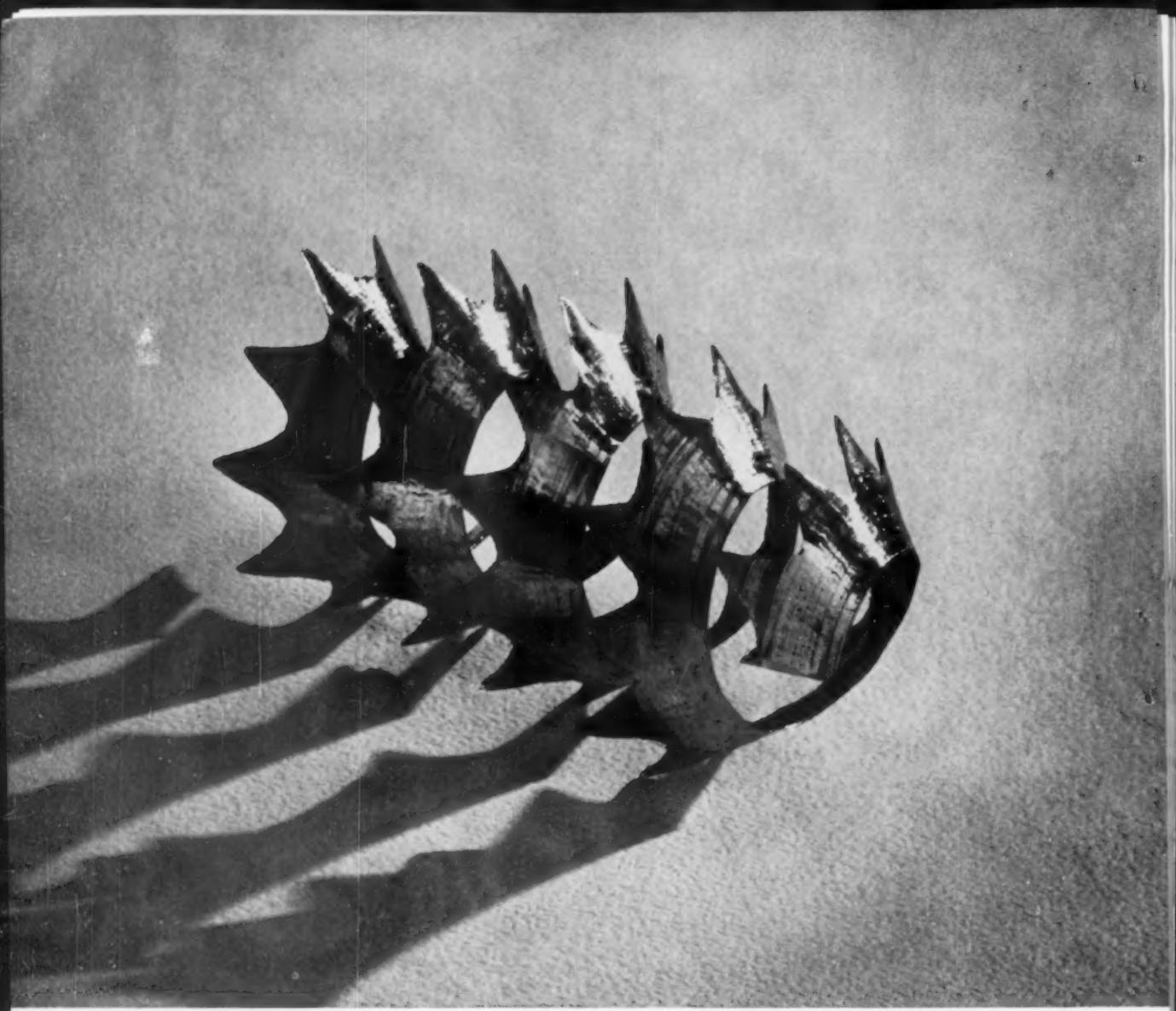

Chip – magnified 4 times – produced by machining Waspalloy with Rex 49

New Rex 49 outlasts other special purpose high speed steels better than 2 to 1

Rex® 49 – a new high speed steel that can machine today's "difficult-to-cut" metals *faster and more economically* than existing special purpose high speed steels – is another in the long line of advances and improvements in specialty steels to come from Crucible research.

Crucible laboratory tests indicate that tools made of Rex 49 last as much as 4 times longer than other special purpose high speed steels . . . and it has a base price ⅓ to ½ of these steels.

Both laboratory and field reports prove the advantages of Rex 49 for machining hard, tough or abrasive metals, such as heat-treated alloy steels, stainless, titanium, and superalloys. These tests also indicate that Rex 49 has advantages in machining the more conventional metals through increased speeds, feeds and depths of cut — and Rex 49 can be hardened with conventional high speed steel heat treating equipment.

Rex 49 is indicative of Crucible's continuing leadership in the development of improved high speed and tool steels.

For more information, write: *Crucible Steel Company of America, Dept. HF26, Four Gateway Center, P. O. Box 88, Pittsburgh 30, Pa.*

CRUCIBLE STEEL COMPANY OF AMERICA

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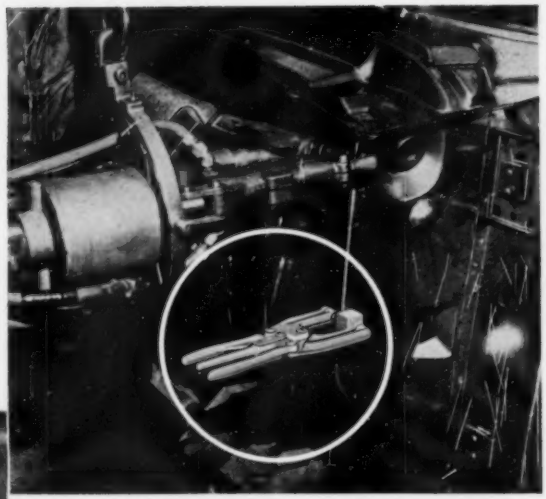
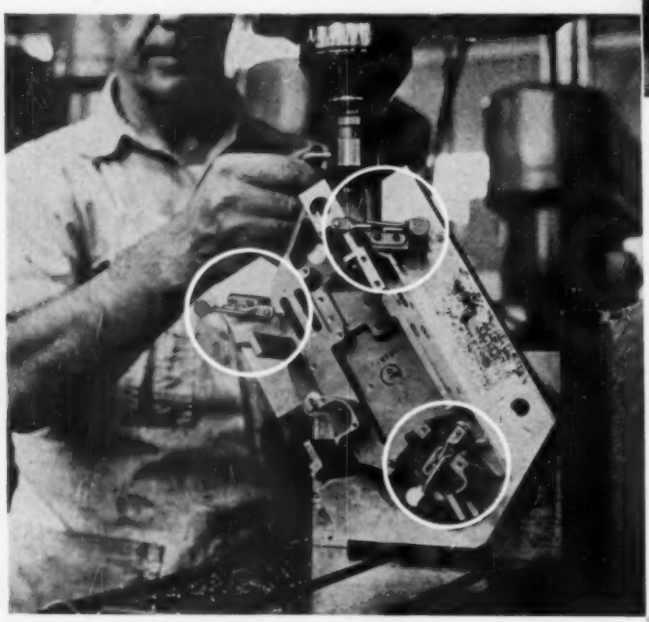
No. 2 of a series

Look what clamps are doing!

Practical uses of Wespo Toggle Clamps and Pliers that may suggest ways you can save

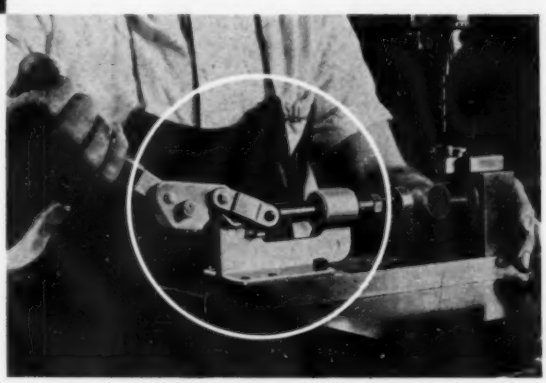




Low Cost Wespo Toggle Pliers have a myriad of uses in assembling operations—as portable clamps, clamping where space is limited, or overhead clamping. Their usefulness as portable clamps is demonstrated in this auto body welding operation. The plier shown has the Wespo "Quick-Trigger" release which permits one hand operation. All Wespo toggle pliers are engineered for fast, positive locking with a minimum amount of hand pressure. They are available in numerous styles and jaw sizes.

This Wespo Push-Pull Clamp serves as a simple fixture to hold a knurled ring securely during the drilling operation. The adjustable spindle is fitted with a large pad which mates with the inside diameter of the ring, holding it securely. Wespo makes a variety of push-pull clamps for use where smooth, horizontal clamping action is required. All models feature the "better 3-ways" Wespo design and are ruggedly built to stand hard use. Some models have locking action in both the "push" and "pull" positions.

Miniature Toggle Clamps, only 2½" overall!—These small, light weight Wespo Series 50 Clamps can do a hundred different jobs on small fixtures such as the one shown above. Their compact design and smooth operation also make them useful in the assembly of small parts, in electronic wiring and soldering operations, on fixtures where space is limited... anywhere a small, rugged clamp is needed. Maximum holding pressure is 35 lbs. Available with a horizontal or vertical mounting base; adjustable spindle.



NEW 16-PAGE WESPO CLAMP CATALOG!

More than 80 different models and sizes of clamps are described to help you quickly select the proper clamp for every clamping job.

Ask your Wespo Distributor for a free copy today.

WESPO

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A SUBSIDIARY OF BARRY WRIGHT CORPORATION
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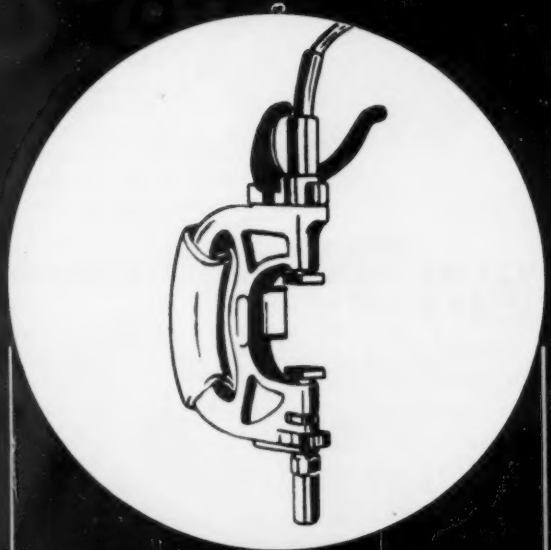
ADJUSTABLE

MAGNIFICATION

WITH ADJUSTABLE AIR GAGES

10 AIRBORE GAGES

COVER .123 TO 24"



12 AIRSNAP GAGES

COVER 0 TO 12"

MEANS MINIMUM COST ON SHORT RUNS

- COMPLETE GAGING SET-UPS CHANGED IN 10 MINUTES — FOR BOTH TOLERANCE AND SIZE.
- .0001 CAN APPEAR LIKE THIS  ON THE DIAL.
- WRITE FOR CATALOG #61 — SEE THE COMPLETE LINE OF STANDARD AIR GAGING EQUIPMENT.

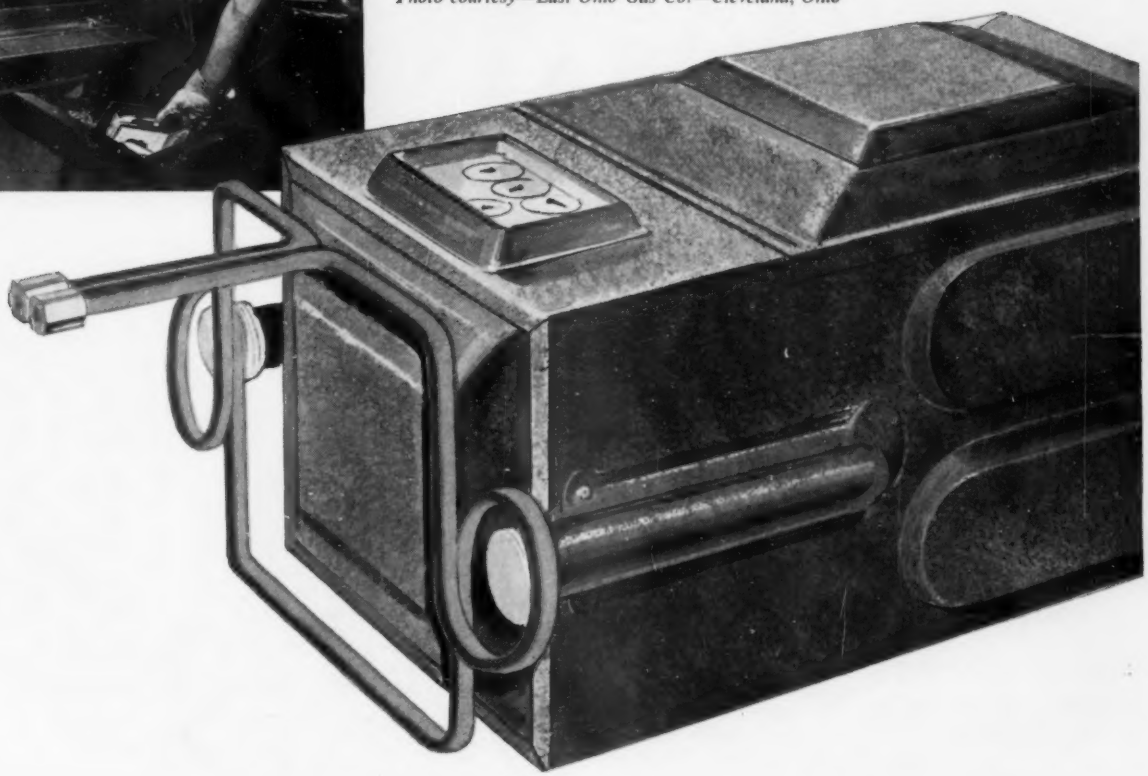
STANDARD GAGE COMPANY, INC.

MANUFACTURERS OF MECHANICAL & AIR GAGING EQUIPMENT

POUGHKEEPSIE, N. Y. TELEPHONE GROVER 1-3100

Operator removes top meter panel from tray where it has fallen after being de-soldered.

Photo courtesy—East Ohio Gas Co.—Cleveland, Ohio



Gas Meters De-Soldered 5 Times Faster

with TOCCO Induction Heating*

In just 60 seconds panels are removed for repair of gas meters—a job which formerly required up to 15 minutes with a conventional soldering iron. East Ohio Gas Co.'s 7½ kw 10,000 c.p.s. TOCCO unit has been giving trouble-free operation for 13 years—handling about 75,000 meters per year.

All sizes of meter panels, from 8″ x 12″ to 30″ x 30″, are de-soldered with only four different induction coils. Changing coils takes about three minutes.

If you have a job involving disassembly, joining —or for that matter, the heating of metals for almost any purpose—look to TOCCO for fast, economical results.

THE OHIO CRANKSHAFT COMPANY

***Mail Coupon Today*—NEW FREE Bulletin**

The Ohio Crankshaft Co. • Dept. G-6, Cleveland 5, Ohio

Please send copy of "Typical Results of TOCCO Induction Brazing and Soldering"

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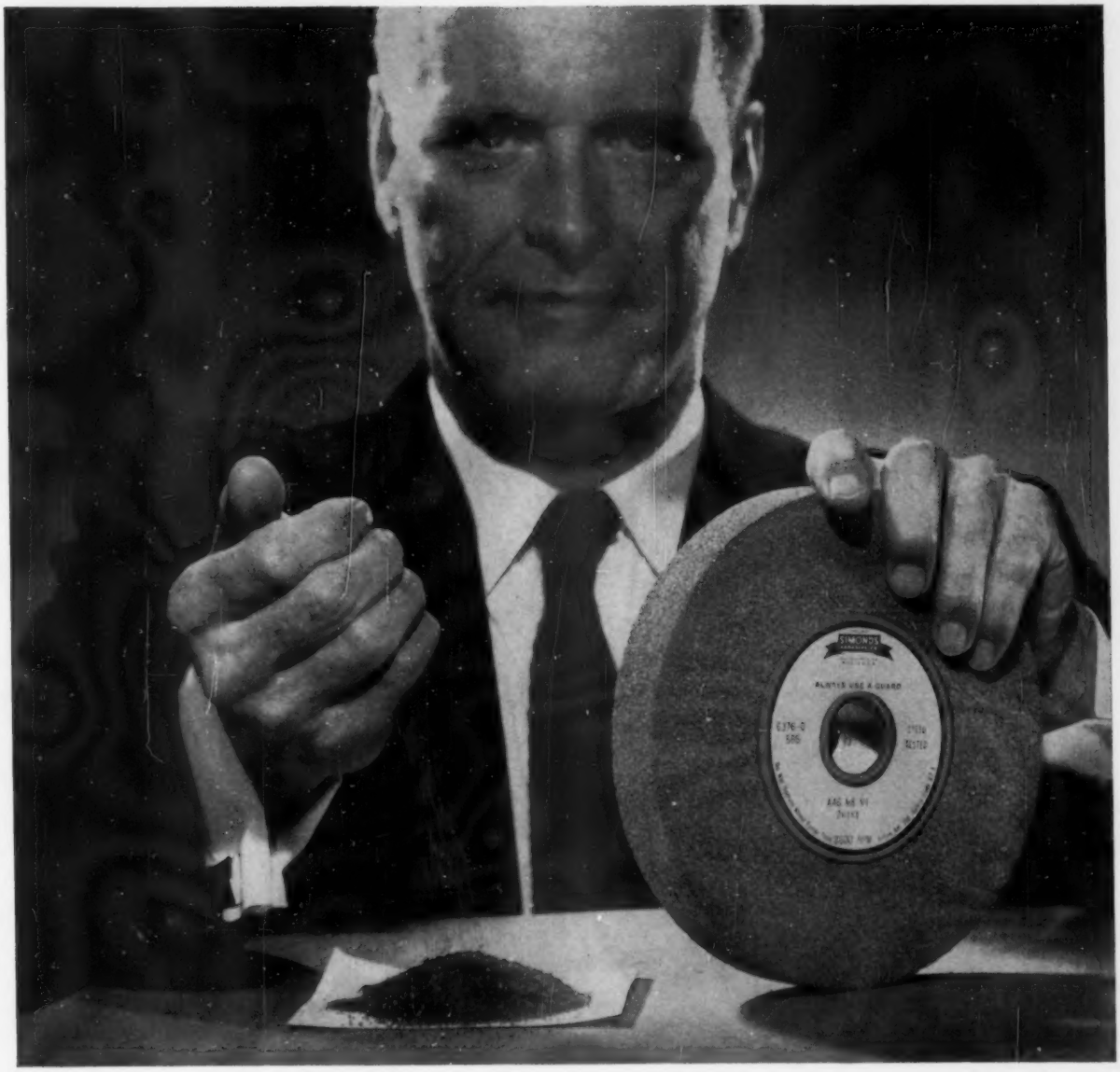
City_____ **Zone**____ **State**_____



Are You getting the advantages of 'GROUND-TO-GRINDING' QUALITY CONTROL?

In cutting action, wheel life and production economies, Simonds grinding wheels give you top value. The reason? Control . . . complete quality control starting with abrasive grain manufactured by Simonds Canada Abrasive Co. Ltd. . . . single-management quality control extending to the finished wheels . . . single-source quality control backed by our technical engineering service . . . in short, ground-to-grinding control that gives Simonds wheels that *extra* efficiency to give your products *extra* value. New illustrated catalog gives the specific advantages. Write for copy on your letterhead.

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SHREVEPORT — IN CANADA: GRINDING WHEELS DIVISION, SIMONDS CANADA SAW CO., LTD., BROCKVILLE, ONTARIO • ABRASIVE PLANT, ARVIDA, QUEBEC

Time is the measure of productivity

Time is the measure of productivity
Time is the measure of productivity

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Time is the measure of productivity

Reduce grinding time and you increase productivity. Norton's many time saving innovations in varied stages of grinding production can reduce your grinding time up to 30%! The story is a profitable one. Here's why —

Norton Grinding Machines are engineered to permit higher wheel speeds to reduce cutting time. Norton's *Automatic Wheel Balancer* balances the wheel in *five seconds— on the machine.* You reduce time spent "grinding air" up to 85% because of Norton's *Automatic Wheel Contact Accelerator* which speeds the wheel to the work and compensates for work piece-diameter variation. Another advance is Norton's *Automatic Truing* which eliminates work interruptions and the *Automatic Wheel Wear Compensator* that stabilizes the grinding cycle.

Norton Grinders further add to your productivity by minimizing work spoilage with *Automatic In-Process Gaging.* In the case of surface grinders Norton *Higher Table Speed of 150 fpm* actually reduces grinding time up to 50%.

These are only some of the many reasons you can increase your productivity with Norton Grinders. They also offer accessories that literally transfer skills to machines — *ultra-fine feed,* and *automatic features* such as *steady resting, endwise locating, loading, constant peripheral wheel speed* and *hydraulically-operated feed screws* provide this competitive advantage.

The decision is yours — can you afford not to reduce the time it takes to produce your product? Can you afford not to increase your productivity? Contact your Norton man, NORTON COMPANY, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. In Canada: J. H. Ryder Machinery Co. Ltd., Toronto 5.

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Non-Slip Floors — **BEAN-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes
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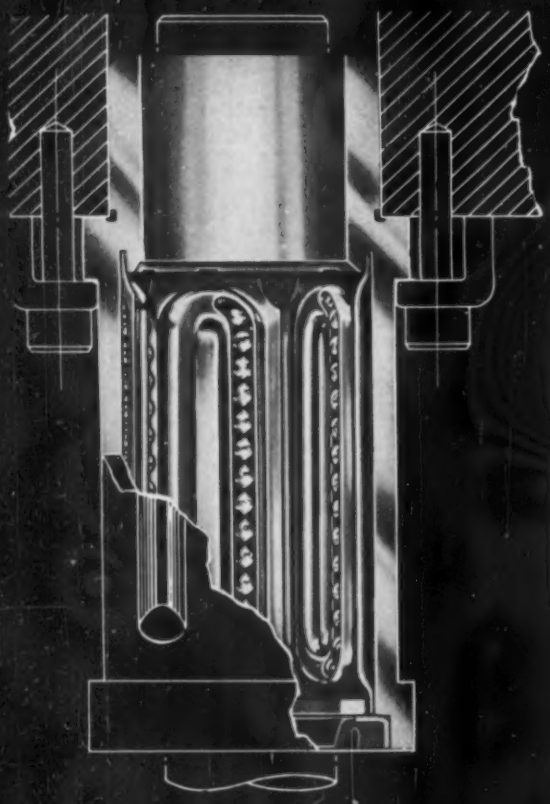
NORTON
MACHINE TOOLS

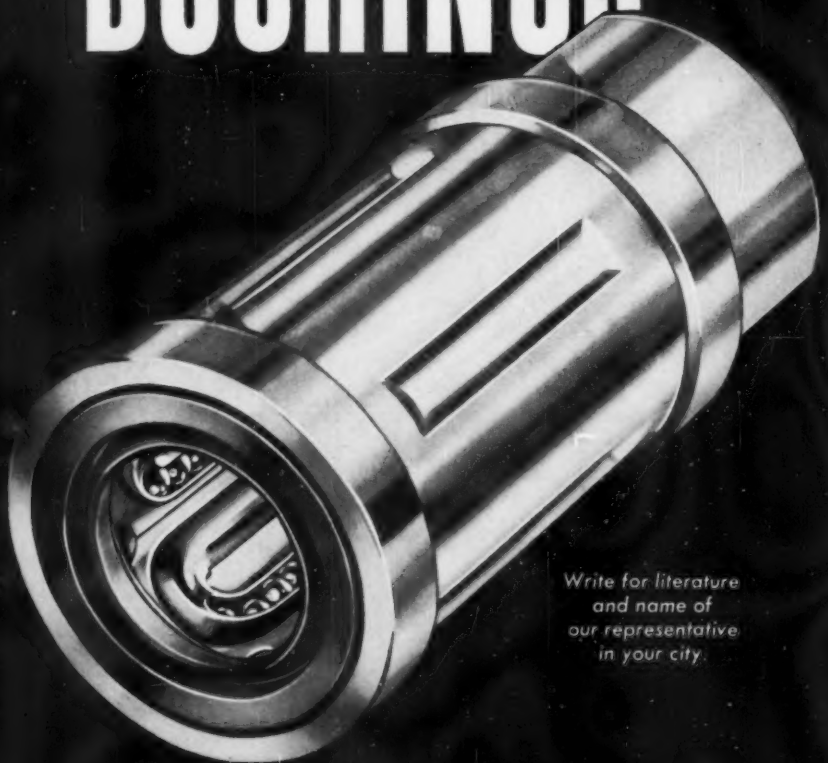
Making better products... to make your products better



THOMSON INTERCHANGEABLE die-set BALL BUSHINGS®

NEW!

GO ANTI-FRICTION
with a simple bushing replacement
and (1) Improve performance of your *present* dies
and (2) Reduce tool room costs



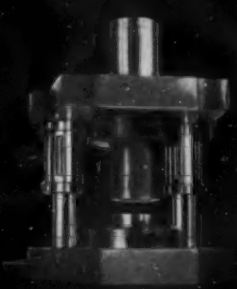
Write for literature and name of our representative in your city.

in the PRESS ROOM

Ball Bushings allow closer fits and maintain alignment which increases die life and permits longer uninterrupted runs. Fewer sharpenings and sustained parts accuracy also result. Periodic lubrication is eliminated and higher speeds are possible. Unlimited travel permits die to be used in any press regardless of stroke. Costly smash-ups due to seizure are eliminated.

in the TOOL ROOM

No cocking and binding . . hence the punch holder "floats" on and off! No time consuming die jacking! Free-rolling *ball* bearings enable the toolmaker to actually "feel in" the fit of mating parts. This saves more time and makes better dies.



THOMSON INDUSTRIES, Inc.
Dept. D2, MANHASSET, NEW YORK

Makers of *60 Case* hardened & ground shafting and NYLINED Bearings . . . Sleeve Bearings of DuPont NYLON

BEST TIP OF ALL!

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION

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Chicago-Latrobe DRILLS

CHICAGO-LATROBE PRODUCES A COMPLETE LINE OF DRILLS, REAMERS, END MILLS, COUNTERSINKS, COUNTERBORES, CARBIDE TIPPED TOOLS, GUN DRILLS, AND THE EXCLUSIVE C-L "LO-TORK" CHIP BREAKER DRILLS. FOR EXPERT ADVICE AND FINEST SERVICE CALL YOUR CHICAGO-LATROBE DISTRIBUTOR.

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Clip and File

DRILLING TIPS YOU CAN USE

Select the Correct Helix

The spiral flutes of a twist drill perform three functions. They bring the chips out of the hole; provides the proper rake angle at the cutting lip; permit coolants to reach the point of the drill. These actions are vital. All are affected by the helix (the angle of spiral) of the flutes. Be certain that the helix you choose is the correct one for the material being drilled.

Regular Helix

This is the familiar style and the best helix for most general purpose shop work in steel, forgings, castings, and other ferrous materials. Where extra rigidity is required—as in portable drilling—select a regular helix drill with heavy duty construction.

Fast Helix

In general the fast helix is selected for drilling materials of low tensile strength like aluminum, magnesium, copper, and thermoplastics. These materials produce a large volume of chips and the low angle of incline of the flutes is specially suitable for their removal. Where chip removal is slowing drilling, the fast helix may solve the problem.

Slow Helix

This drill is generally used for materials that break up into very small or powdery chips . . . as occurs in drilling brass; hard rubber; thermo-setting plastics such as bakelite; fibre and plastic laminates. These drills are of light construction with wide flutes and are not usually suitable for heavy duty work.

USE CHICAGO-LATROBE CATALOG NUMBER 60

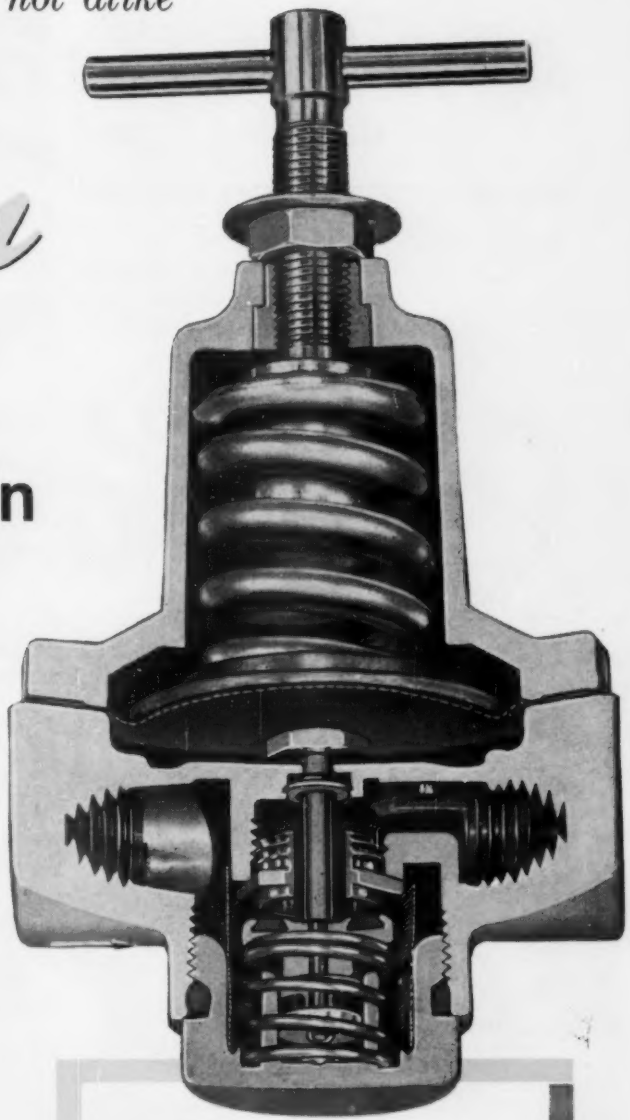
for the most complete listings of drills of all types—plus valuable advice on their use. INCLUDES PRICES.

All Pressure Regulators are not alike

Norgren

Floating Valve-Pin

A Norgren extra that assures leak-proof seating of the regulator valve



A tight, leak-proof seating of the valve is essential to the proper performance of a pressure regulator. Leakage and creep can be caused by improper alignment of the valve-pin, resulting in gouges and excessive wear on the valve seats.

To prevent this, Norgren Regulators are made with a floating valve-pin, eliminating critical alignment problems. The Norgren floating valve-pin is self-aligning, assuring positive seating of the valve. As a result, there is minimum wear on the valve seat, with increased service life and more dependable regulator performance.

Whatever your pressure regulation need, there is a Norgren Pressure Regulator designed for the job. Call your nearby Norgren Representative listed in your telephone directory—or write factory for literature showing complete Norgren Regulator line.

Norgren Pressure Regulators give you these important features:

Balanced Valve Construction—improved regulator performance

Large Nylon-reinforced Synthetic Rubber Diaphragm—long service life

Baffle and Siphon Tube—increased accuracy

Large Passages and Valve Openings—large flow capacity

Easy servicing while still on fluid-line

Floating Valve-Pin—assures better seating

FOUNDED IN 1926

C. A. NORGREN CO.

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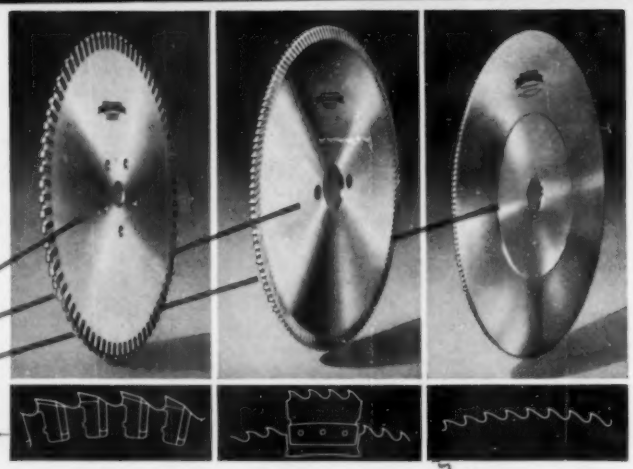
Do you cut ferrous metals? If so, Simonds has three basic saw designs for you:

INSERTED TOOTH METAL SAWS

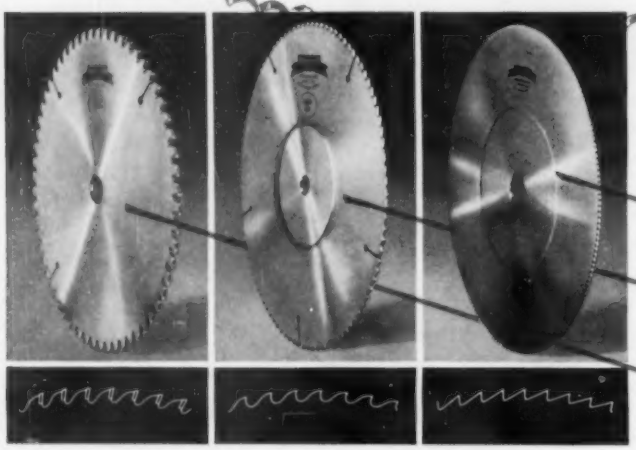
SEGMENTAL SAWS

SOLID TYPE SAWS

Available in High Speed and Semi-High Speed Steels



There's a SIMONDS Circular Saw Exactly Right for Your Metal Cutting Job



If you're cutting non-ferrous metals, Simonds offers you:

SOLID STEEL SAWS
Available in "Si-Maloy", in High-Speed Steel for cutting where extreme abrasiveness is present, and in Semi-High Speed Steel.

HIGH SPEED STEEL, HARD RIM SAWS
Hard cutting edge, soft center gives you long life coupled with safety.

CARBIDE TIPPED SAWS
for cutting aluminum and magnesium, as well as other non-ferrous metals

No matter what kind of metal you're working, there's a quality Simonds blade just right — a blade that means faster, cleaner cuts, longer blade life and maximum performance.

Find out how a Simonds Circular Metal Cutting Saw can mean important savings for you.

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SAW AND STEEL CO.
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Factory Branches in Union, N. J., Chicago, Shreveport, La., Los Angeles, San Francisco, Portland, Ore. • Canadian Factory in Granby, Que. • Simonds Divisions: Simonds Steel Mill, Lockport, N. Y.; Heller Tool Co., Newcomerstown, Ohio; Simonds Abrasive Co., Philadelphia, Pa. and Arvida, Que., Can.

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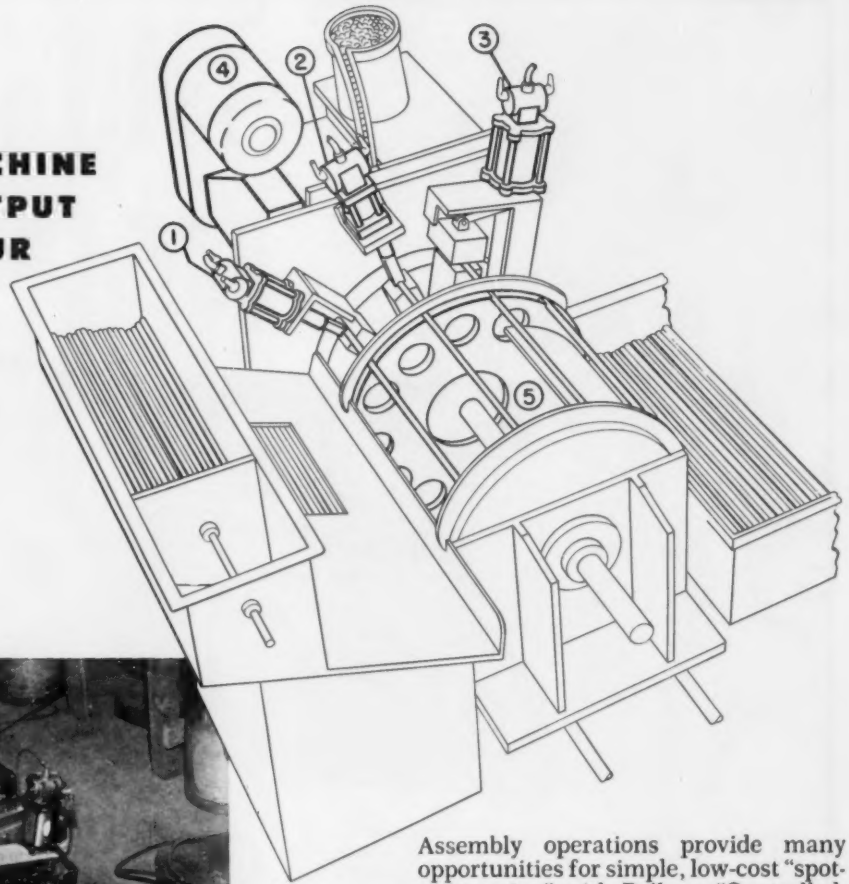
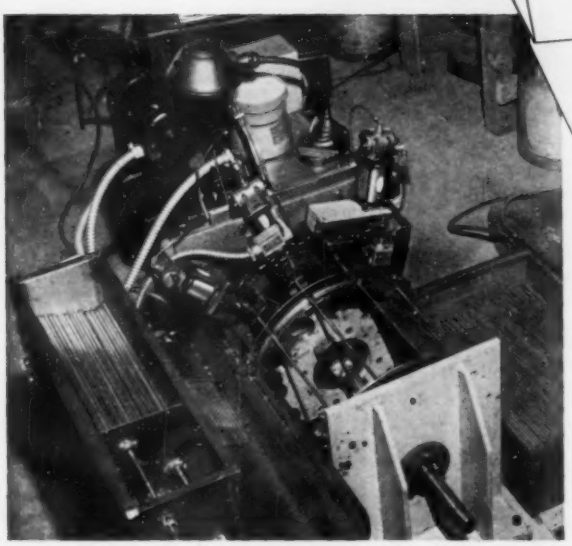
THIS SHOP-BUILT MACHINE INCREASED OUTPUT PER MAN-HOUR 500%



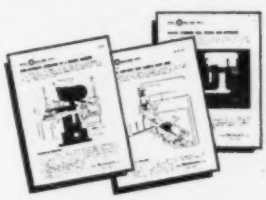


Incorporating five Bellows Air Motors (#1, #2, #3, plus two others, horizontally-mounted, not visible) and a Bellows Drill Unit (#4), all electrically interlocked with the vertically-mounted Bellows Rotary Table (#5) which feeds the workpieces through the various operations, this machine counterbores one end of a .300" brass tube, inserts a small plastic seal, curls the end of the tube to retain the seal and delivers the completed antenna sub-assembly into a hopper ready for plating.

Assembly operations provide many opportunities for simple, low-cost "spot-automation" with Bellows "Controlled-Air-Power" Devices. Costs go down immediately as these versatile work units boost the productivity of each worker.

A case in point is this machine, built entirely around Bellows "Controlled-Air-Power" Devices, which performs an assembly sequence in the manufacture of automobile antennas. Designed by the Plant Superintendent working with a Bellows Field Engineer, the unit requires only one operator (who merely loads and unloads hoppers), yet produces the same number of pieces as five assemblers working manually.

This machine is typical of the ways that cost-conscious men are using Bellows "Controlled-Air-Power" Devices — either singly or in combinations — to perform a virtually-unlimited range of operations. It's almost a certainty that Bellows units can help you meet — *or exceed* — cost reduction goals in *your* plant, too.



THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST

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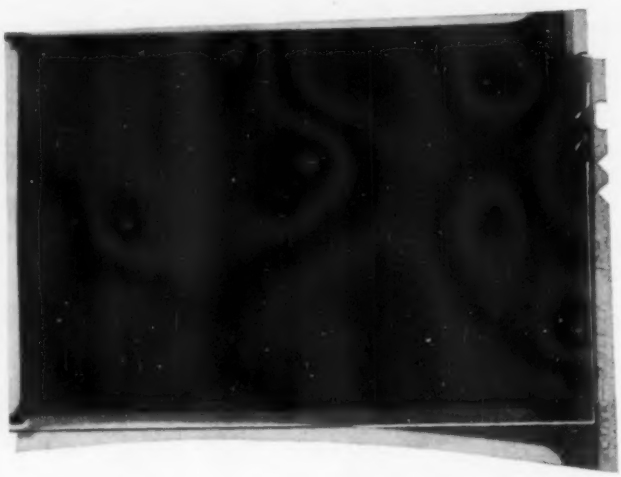

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TOOL CRIB SECTION

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TOOL CRIB SECTION

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ASTME COLLECTED PAPERS, VOL. 61, BOOK 1 may be ordered now. The set embraces papers presented at the 1961 American Society of Tool and Manufacturing Engineers Convention Engineering Conference in New York City, New York, May 22-26, 1961. The set includes all papers for which manuscripts were received in time for preprinting. A complete list of the individual papers presented is given below:

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Recent Developments in Metal Cutting Carbides	328
Physical Properties and Applications of Various Steel-Bonded Carbides	329
Evaluation of Ceramic Tools	330
Ultra High Speed and Other Metal Cutting Phenomena Explored by Dimensional Analysis	331
Heat Treating Instruments	332
Those Elusive Millionths	333
New Techniques of Metal Removal Through Vibratory Finishing and Deburring	334
Electron Beam Process for Super Alloys	335
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Understanding the Language of Metrology	339
Surface Finish and Other Surface Specifications	340
Controlling Surface Finishes With Interferometers	341
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The Application of Stylus Inspection Methods in Ball and Bearing Manufacturing	346
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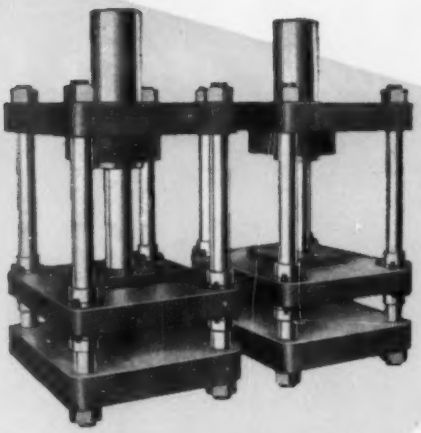

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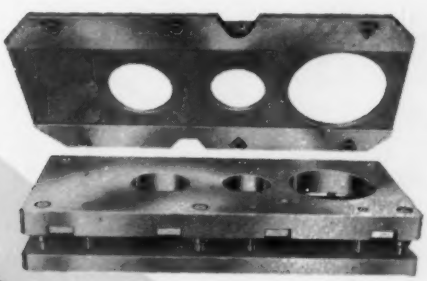

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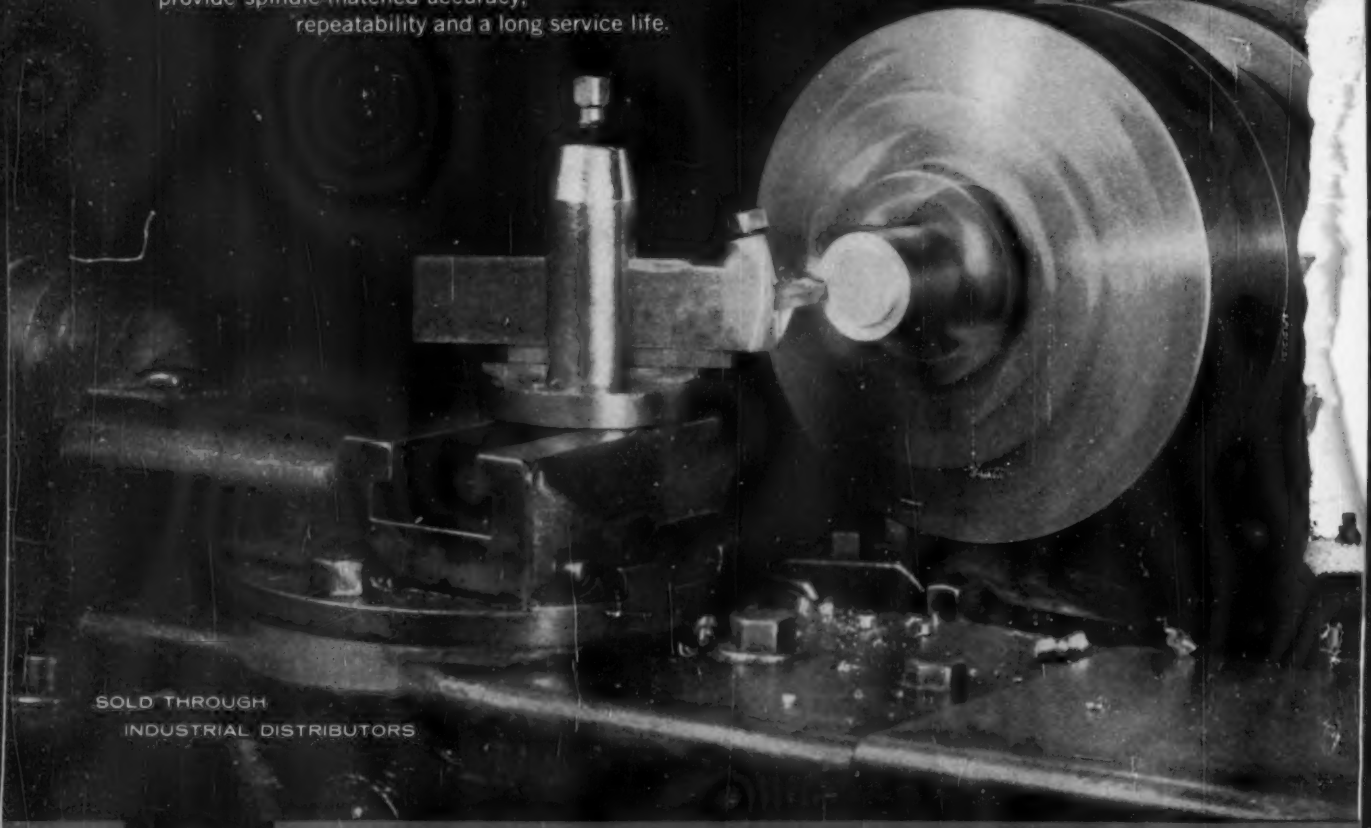

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Index of Advertisers

June 1961

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***Exhibitor in 1961 ASTME Tool Exposition** **†March 15, 1961 Manufacturing Planning Issue**

Most of the companies listed below have informative listings in the March 15, 1961 Manufacturing Planning Issue

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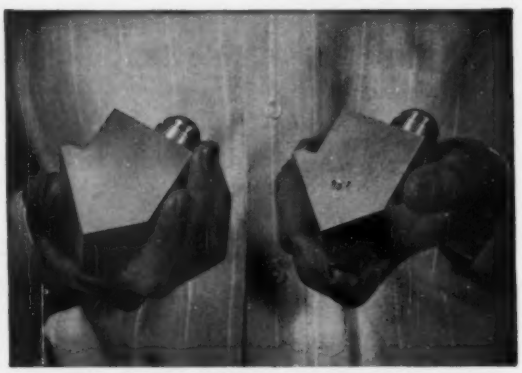
Practical Tooling Tips

Number 1 of a series

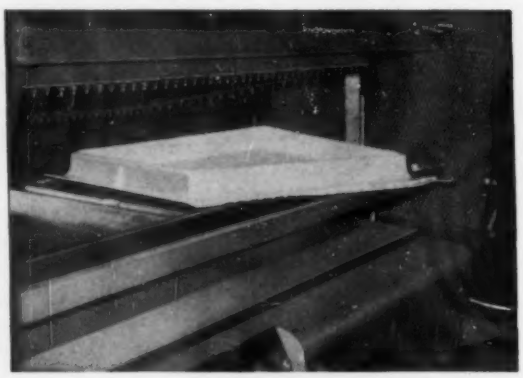
Everyday more and more shops are using standard Vlier Tooling Accessories in place of custom-made devices for both tooling and original equipment applications. The precision construction, product uniformity and quick availability of these simple time-savers have made them tool room favorites. Why don't you start saving from their use?

TO GET GREATER TOOL BIT RIGIDITY replace the tool holder screw with a Vlier Swivel-Pad® Clamp. The large, flat pad face provides many times more clamping area. Bits can be held tighter, reducing chatter and vibration. Small, narrow cut-off blades, multipoint tools, even stub ends can be rigidly held. Unique ball joint construction gives smooth angle adjustment in all directions.



EASY WAY TO STOP MARRING surface of part held in fixture. The part on the left was securely held in the fixture with a Vlier Swivel-Pad® Clamp. The scrapped part on the right was held with an ordinary set screw. With the Vlier Swivel-Pad® Clamp the pad stops at first contact with the part; screw torque is absorbed by a ball, preventing damage to the part. This exclusive ball joint construction also provides adjustment to off-angle surfaces.

SPRING PLUNGERS LET WRENCH DO MULTIPLE DUTY—The compression tool shown above is used to attach connectors to electrical wires. Formerly, each size wire connector required a different size tool. But now, through the use of Vlier Spring Plungers, one tool attaches all sizes of connectors—through the use of changeable jaws. The appropriate jaw for any size connector is easily inserted, accurately positioned, and held in place with a Vlier Spring Plunger.



THE RIGHT AMOUNT OF END PRESSURE AND NO MORE is what this spring plunger application calls for. More than 150 Vlier Spring Plungers are used to hold a plastic sheet in position during the forming operation of a plastic refrigerator door liner. Spring Plungers provide just the right amount of pressure to produce a perfect liner.

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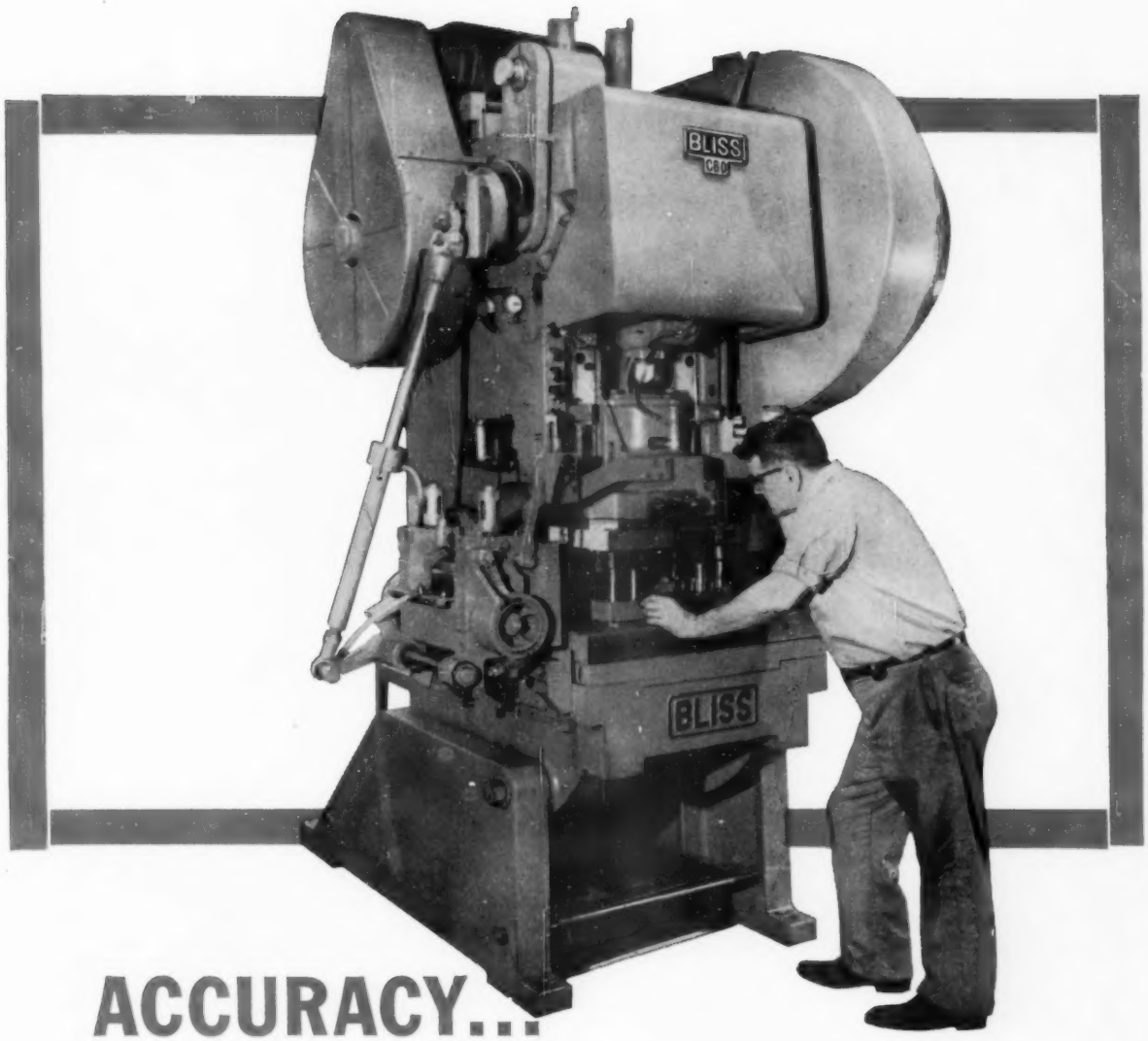

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